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ABSTRACT

A teacher's guide and student resource book developed by geography, social studies and economics teachers comprise this teaching kit. The kit was developed to help seventh through twelfth grade students understand the links between population and the environment in the context of sustainable development. The goal of the project is to develop students' concern for the environment, a sense of responsibility for its protection, awareness of the links between population and the environment and the realization that they live in a global village. The "Student Resource Guide" consists of articles written by journalists in developing countries. In an effort to give students a view of global problems from a perspective different than that of the United States, the articles are unedited and contain some inconsistencies with respect to the word usage and spelling. The readings in the student materials are divided into geographic units: the world, Africa, Asia and Latin America. Within each unit is an article on the entire region, and when available, on specific countries in that region. The "Teacher's Guide" consists of 27 lessons that complement the articles. The lessons expand on selected concepts and issues and help students make the connections between population growth, environmental concerns and sustainable development. Accompanying worksheets can be found at the end of the lessons. The teacher's guide contains a learning matrix showing the countries, topics and skills that are covered in each lesson or reading. Each section begins with a resource listing of additional books, articles and audiovisual aids. (MCO)

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CONNECTIONS

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Linking Population and the Environment

Student Resource Book

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CONNECTIONS

Linking Population and the Environment

Student Resource Guide

Edited by Kimberly A. Crews and Patricia Cancellier
Published by The Population Reference Bureau, Inc.
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1991

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Ordering Information: Additional copies of the *Student Resource Book* are $8.00 each. Complete teacher's kit $13.00 (includes *Teacher's Guide, Student Resource Book, World Population Data Sheet* and *World Environment Data Sheet*). Data sheets are $3.00 each. Orders under $50.00 must be prepaid with a $1.00 or 3 percent (whichever is greater) for shipping and handling. Call 1-800-877-9881 for additional information and bulk orders. Send orders to PRB, 1875 Conncecticut Avenue, N.W., Suite 520, Washington, D.C. 20009-5728.

This *Student Resource Book* is part of the CONNECTIONS teaching kit developed to help students understand the links between population and the environment in the context of sustainable development. The ultimate goal of the project is to develop students' concern for the environment, a sense of responsibility for its protection, awareness of the links between population and the environment and a realization that they live in a global village.

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The Challenge of Our Times

"Humanity has the ability to make development sustainable—to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits—not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can be both managed and improved to make way for a new era of economic growth. The Commission believes that widespread poverty is no longer inevitable. Poverty is not only an evil in itself, but sustainable development requires meeting the basic needs of all and extending to all the opportunity to fulfill their aspiration for a better life. A world in which poverty is endemic will always be prone to ecological and other catastrophes."

From Our Common Future, *report of the World Commission on Environment and Development, 1987.*

Our challenge: to meet our needs, without compromising their future.

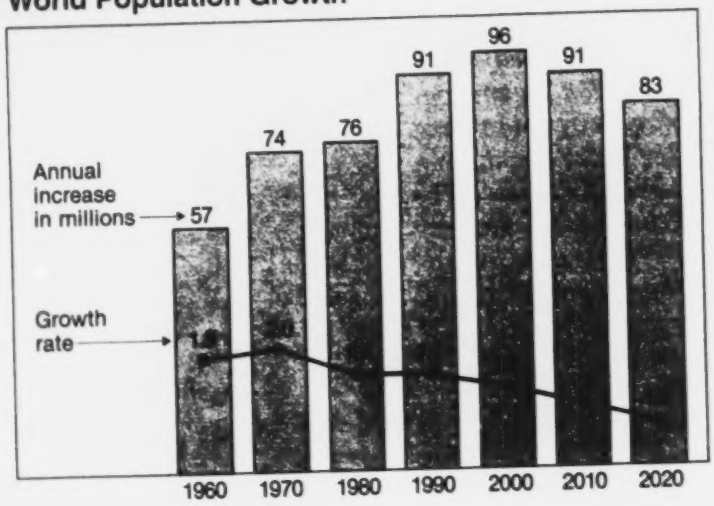
Part 1 Introduction

Child 5-Billion

July 11, 1987 was designated as the day the world reached a record population of 5 billion. The event was symbolic. It was impossible to calculate precisely when and where the baby was born who achieved the magic number. **Child 5-Billion** could be a boy in the Ghanian town of Tamale, a girl in the teeming Indian city of Calcutta, or a child in your neighborhood. No matter where the symbolic child was born, the question remains: What will it take to give that child and its family the most basic elements of human existence—good food, clean water and clean air?

Child 5-Billion entered a new age of sharply limited options. The availability of renewable resources for a growing world population is so precarious in many lands that misguided development decisions are becoming irreversible. Good land turns into desert, or is flooded and salinized by inappropriate irrigation Drinking water is spoiled by chemicals. Unique plant and animal species are destroyed by bulldozers or slash-and-burn agriculture. Tropical forests are cut down and the exposed soil turns rock-hard. Contaminated lakes and coastal waters become lifeless. Precious topsoil is carried off to the ocean. Some regions are so ravaged that the local climate is changed, and in a variety of other ways man has lost his margin for error. Any considera-

Figure 1
World Population Growth



Source: Population Reference Bureau

tion of conservation starts with population. **Child 5-Billion**'s birth in 1987 signaled a doubling of the world's 2.6 billion population of 1950 in only 37 years. Today's annual 1.8 percent rate of global population growth is a slight step down from the peak rate of 2 percent in the late 1960s. Despite this decline, however, roughly 250,000 people are added every day. Demand for food, shelter and social services will be increased by the more than 90 million human beings added over the next year.

Population Increases

It is most likely that **Child 5-Billion** was born to a relatively poor family; 90 percent of the newborns of the world now arrive in the less developed countries (LDCs). The less developed world, excluding China, has an annual rate of natural increase four times greater than the more developed world's rate. In part, the mounting numbers result from improved international health standards that have saved Third World children from such ancient killers as smallpox.

If current rates continue, the less developed world will double its population every 33 years, compared to 128 years in the more developed world.

Despite falling growth rates, births and deaths are not projected to balance each other for more than 100 years, when the population of the world is expected to more than double to a peak of 10.6 billion (see Figure 2). The soaring number of births experienced in the recent past has created momentum for future growth in the total global population: a heavy concentration of young people in the Third World is reaching childbearing age.

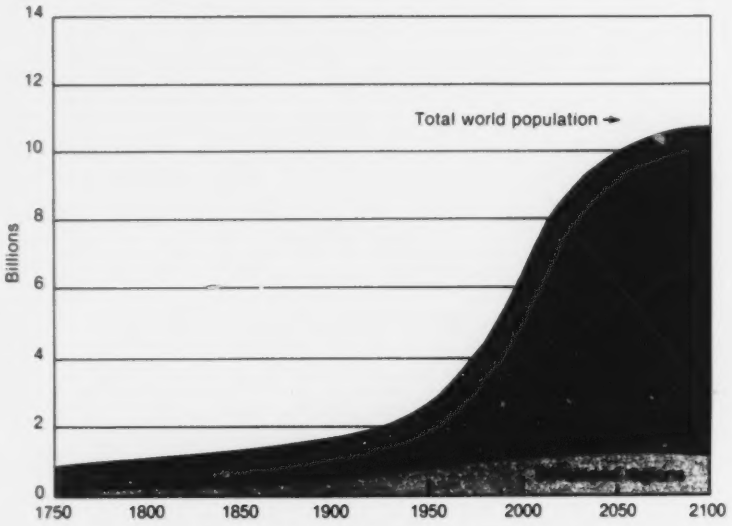
Thus, even if couples choose only to replace themselves by having two children, a surge in population growth is inevitable until deaths balance births at the end of the next century. "It's like hitting the brake on a long freight train," observes Dr. Mercedes Concepcion. "Long after the brake bites, that train continues on, due to momentum."

Child 5-Billion theoretically could be the older brother of **Child 6-Billion**, projected to be born only 8 years from now, and the father of **Child 7-Billion**, expected to be born in the year 2012. And taking the analogy one final step, it is not impossible that the parents of **Child 5-Billion** (if born in 1950 and live to 2020) will see the world's population nearly quadruple in their lifetimes. Successfully absorbing these astonishing population increases is the challenge of our times. The avalanche of newcomers on the earth puts obvious pressure on the fragile lifeline between man and his sustaining environment:

Food—Rapid population increases force expanded agricultural output, which invites over-cultivation, over-grazing and over-irrigation that, in turn, can degrade soils and decrease productivity. Rising demand for fuelwood contributes to deforestation and soil erosion. The build-up of cities onto agricultural lands forces cultivation of more marginal soil.

Figure 2

World Population Growth: 1750-2100



Air and Water—The increasing world population raises the demand for services that tax the quality of air and water. The greater the population, the greater the competition for scarce water for industry, agriculture and personal use.

The core concept of sustainable development is balance. The single greatest threat to the common future is neither rapid population growth nor shortsighted development practices alone. But the unchecked excesses of both could interact to plunder the planet's carrying capacity.

Food for All

How will society feed today's children and the coming generations? The world at the moment has, in fact, enough food

Rapid population growth forces the use of marginal land for grazing and cultivation.

to feed everyone—if available stocks could be distributed fairly. But global food supplies are an unreliable indicator of who gets what. A survey on food found that roughly 500 million persons—or about one out of 10 people on earth—were "seriously undernourished."

Food Production—Even if the problem of unequal access to food miraculously vanished, more food would have to be produced to keep up with the Third World's increasing numbers, now expanding by nearly 90 million a year. The food survey concluded: "By the end of the century the entire lands of developing countries—almost three times the present cultivated areas—would barely be sufficient to feed their expected populations if traditional methods of farming continue to be used."

Land—Cropland, the main source of food, can be damaged or degraded in a variety of ways, from being paved over for urban streets to being waterlogged by excessive irrigation. Further, roughly a third of cropland is used for non-food purposes, such as tobacco, coffee and tea, cotton, human settlements, parks, mining, roads, catchments or at rest for soil rejuvenation.

Land degradation could reduce food production over the long haul by nearly 20 percent if conservation measures are not taken. Some 544 million hectares of essential rain-fed croplands could be lost.

Hectare
1 hectare = 2.47 acres
544 million hectares is about two-thirds of the size of Australia.

During the 24 hours following the birth of **Child 5-Billion**, roughly 50 million tons of topsoil, which took centuries to accumulate, were irretrievably swept off the world's croplands, and the rate of loss is rising. Yet **Child 5-Billion** was only one of approximately 250,000 more people added that day to the world's number of mouths to feed.

Closing Frontiers—Before now, new croplands could be opened up to feed the world's expanding population. Cropland nearly tripled from 1850 to 1980, from 538 to 1,501 million hectares. But now many regions of the world are running out of land to clear.

Modern technology can increase land productivity. The current hope is that through the use of genetics, more productive and adaptable crops may be invented. It will be some time before

results are seen. Further, the potentially negative side effects of such genetic developments have not been fully examined.

In theory, enough food can be grown in the foreseeable future to feed all—provided that modern technology and good land management are used on all arable lands and the world's harvest is made universally available. However, undernourishment and famine will stalk the Third World for the near future.

Water

Agriculture is the prime user of water. Even in the United States, more than 80 percent of all water used goes to grow food and fiber, with less than 20 percent going to industry and direct human consumption.

Child 5-Billion and his growing number of contemporaries increase the need to divert water to boost agricultural and industrial production. Unless scientifically and carefully applied, irrigation can both flood lands, drown plant roots and ruin productive lands by spreading dangerous concentrations of chemicals. Further, the chemical-carrying waters may ruin downstream ecosystems of marine life.

Table 1

Percent of Population with Access to Drinking Water and Sanitation Services: Developing Countries1985

	Drinking Water		Sanitation Services	
	Rural	Urban	Rural	Urban
Africa	77	25	75	18
Latin America	86	45	79	16
Southeast Asia	67	47	33	10
Eastern Mediterranean	89	29	70	9
West Pacific	75	47	94	66
Total	75	42	59	16

Source: United Nations

Potable **Water**—While representing only a small percentage of world consumption, drinking water is the essence of human life. Sewage, chemical run-offs from agricultural lands and industrial waste pollute the water of roughly 1.7 billion people. And more than 2 billion people in developing countries still lack access to adequate sanitation facilities (see Table 1).

Air

The air we breathe is taken for granted until there is a catastrophic event, such as the Chernobyl nuclear reactor meltdown in the Soviet Union or the toxic leak at the Bhopal pesticide factory in India.

Air pollution is dangerous for millions of urban dwellers. Constant emissions from factories, cars and a wide variety of

industrial processes increase the chances of cardiovascular and respiratory ailments.

The accumulation of carbon dioxide from the increasing use of oil and gas, slash-and-burn agriculture and the discharge of other gases raises the earth's temperature causing the "greenhouse effect." Global warming could turn polar ice caps into flood waters along continental coasts, change basic weather patterns, ruin the earth's protective ozone shield against cancer-causing sun rays, alter food producing capacities and interrupt traditional food chains. Scientists have already found an ominous enlargement of a hole in the ozone layer over Antarctica, a development whose implications await further study.

Part 2 Child 5-Billion Case Studies

Children of Hope

Despite harbingers of scarcity and doom, **Child 5-Billion** did not come into a world without hope. His life expectancy is 61 years, 10 to 12 years longer than his parents', and he has a better chance of receiving some education. As things stand now, what is his future—the future of our children? Let's take a look at some randomly selected countries:

Child of Haiti—If **Child 5-Billion** is Haitian, he was born into a world very different from his parents' early surroundings. In 1950 Haiti still had 80 percent of the forest that covered the lush land discovered by Columbus nearly 500 years ago.

Although most Haitians were poor in 1950, one could still see why this Caribbean island was once France's richest colony, known for its great outflow of indigo, sugar, coffee, sisal, tobacco, cotton, fruits and mahogany. Now the population is 6.5 million and could double in 32 years. Less than 10 percent of its forest cover remains.

When it rains, water cascades down the stripped hills and takes the remaining topsoil with it. In the capital, Port-au-Prince, electricity is rationed because the Peligre Dam, a major hydroelectric facility, is clogged with sediment. Viewed from above, the blue ocean around Haiti tells a story of ecological reversal; the river mouths discharge great billows of brown earth into the sea. Topsoil, it is grimly remarked, is now Haiti's biggest export.

Discouraged peasants flock to Port-au-Prince, goats eat

anything that grows and Haitians forage the hillsides for one of the few remaining cash producers—wood for charcoal. Fuelwood and charcoal, which 90 percent of the people depend on for cooking and heating, are expected to run out by the end of this century at the present rate of use.

Child of Mauritania—If **Child 5-Billion** is Mauritanian, he might have been born in the urban areas around Nouakchott, the capital. Nearly 40 percent of Mauritanians live in cities. **Child 5-Billion**'s parents probably came from the countryside, where only 20 years ago more than 93 percent of the population was born. In 1960, the capital had roughly 20,000 inhabitants; now the city's population is 350,000, mostly refugees from drought and desertification.

Drought is cyclical in the semi-arid Sahelian lands, which cut a 3,000-mile swath across north-central Africa. Nomads there were once in harmony with the fragile ecosystem. The numbers of people and their animals were in concert with available land and water.

But today the Sahel is in a tragic downspin. As the nomadic population increased, so did the number of cattle, camels and goats; lands were overgrazed and more and more trees were cut down for firewood, traditionally used for cooking by the population. As firewood became scarcer, cattle dung, once an important fertilizer of the soil, became the primary cooking fuel. In addition, outside technicians taught Sahelians to plant cash crops like cotton, which rob the soil of nutrients with repeated plantings.

Underground water was tapped. But quickly each new well attracted more people and cattle than it could carry. Desertification, the creeping capture of marginal croplands by lifeless sand, increased. Trees, planted to stop erosion, were scavenged for fuelwood. Vegetation around water holes was trampled by humans and animals. Every relief measure, it seemed, was countered by some unforeseen development.

Child of Nepal—If **Child 5-Billion** is Nepalese, he may face the uncertain future of a refugee from ecological disaster. The Middle Mountains of Nepal hold 7 million people whose carefully balanced use of the Himalayan uplands has been completely upset.

In the past, the Nepalese have terraced hillsides and exhaustively farmed the tightly limited area. The good farmland was kept fertile by crop rotation that restored nutrients. In addition,

"If the present rate of desertification continues, by the end of the century [some Africans] may not be able to get firewood closer than 900 miles from some major cities, such as Khartoum, Sudan. It is a worldwide problem, and to stop it throughout the world would take 20 years of concerted effort at a cost of $4.5 billion a year. The poor countries, such as those in the Sahel, would require an additional $2.4 billion. A lot of money, yes, but what we are losing today as a result of desertification amounts to $26 billion a year."

Mostafa K. Tolba,
Executive Director
of the United Nations
Environment Programme

the system allowed some resting of the land, and the number of farm animals was held at a minimum.

Increased population brought on the same kind of ecological downturn in the mountains that afflicted the semi-arid Sahelian lowlands. More people meant more animals, less resting of the land, increased cutting of trees and more use of manure for fuel, depriving the land of nutrients for the soil. Wide-scale erosion occurred and water runoffs accelerated. The terraces slid down the mountainsides, often taking houses and people with them.

Child 5-Billion's parents and fellow villagers in Nepal now get up at sunrise to gather wood and return at sundown with only enough fuel for three or four days. Many people of the Middle Mountains no longer can feed themselves and their animals; they have been forced to leave.

The plight of the people of the Middle Mountains has a far wider impact. While roughly 50 million people inhabit the transnational Himalayan uplands of Nepal, India and Pakistan, the area is the watershed for 400 million people of the lowland plains of Bangladesh, India and Pakistan. The deforestation causes flooding, runoff of topsoil and silting of dams, irrigation systems and reservoirs.

Child of Yemen—If **Child 5-Billion** is a Yemeni from Sanaa, the capital, he may seem to have been born into the best of times. The consumption of water in the capital and surrounding highlands doubled between 1972 and 1987.

The city and the surrounding agricultural area have prospered. The agricultural center of the nation had long experienced the phenomenon of streams that disappeared into the land, seemingly never to emerge. Modern pumps and drills tapped deep underground waters for the first time. The central government estimates that the capital's population will nearly double its current figure of 347,000 by the year 2000.

By tradition, tribal families can pump water from their lands as they see fit. Irreplaceable reservoirs, some estimated to be 20,000 years old, are being drained. The whole region is expected to experience a critical shortage of water at the turn of the century. As he approaches adulthood, **Child 5-Billion** may well discover that his beautiful and ancient city's way of life will literally crumble for lack of water.

Child of Brazil—If **Child 5-Billion** was born in São Paulo, Brazil's

great industrial city, he is probably poor, facing a lifelong struggle in an urban maze. Refugees from the overpopulated countryside have poured into the city looking for jobs.

From a population of 1 million and an area of 150 square kilometers in 1930, metropolitan São Paulo has grown dramatically. Today the city has about 18 million inhabitants on 1,400 square kilometers and is projected to have 24 million people in the year 2000.

Kilometer
1 square kilometer = 0.386 square miles
1,400 square kilometers = 540 square miles

São Paulo has created industrial jobs in a huge automobile industry. It has fashioned a new middle-class existence for thousands of Brazilians in the banking business and opened up job opportunities in the service industries. In common with many Third World countries, the central government invests most of government funds in city services and modernization of cities. But a high proportion of Paulistas live on the margin—ill-housed, ill-fed, poorly educated and unemployed.

Automobiles, a great source of industrial jobs, are the largest single cause of the city's air pollution. Increasing death rates of infants and the elderly are related to the more than 8,000 tons of pollutants that daily foul São Paulo's air. The Brazilian metropolis' two main rivers are drains for sewage and toxic waste.

Air and water pollution do not recognize national boundaries.

Shared Problems

Whether **Child 5-Billion** is Haitian, Mauritanian, Nepalese, Yemeni, Brazilian or the citizen of any other Third World country, he will probably live on the thin edge of human existence. If he is a citizen of the United States or any other developed country, he may have an easier life. Individually, he is in the care of his nation; collectively, the newcomers are a challenge for global management.

Perhaps the toughest environmental issue is the use of finite resources. Carbon emissions from oil and gas damage the air that humans breathe and industrial waste fouls mankind's fishing waters. Optimists argue that human ingenuity will find answers to the problems brought about by automobiles, chemical waste and smokestacks.

However, the shared dangers to the biosphere, while abso-

"Many present efforts to guard and maintain human progress, to meet human needs and to realize human ambitions are simply unsustainable – in both rich and poor nations. They draw too heavily, too quickly, on already overdrawn environmental resource accounts to be affordable far into the future without bankrupting those accounts. They may show profits on the balance of our generation, but our children will inherit the losses. We borrow environmental capital from future generations with no intention or prospect of repaying... [T]hey cannot challenge our decisions."

From Our Common Future, *report of the World Commission on Environment and Development*

lutely critical to local areas, call for action at the international level and a collective sense of responsibility, especially among the industrialized nations.

Local Initiative

How, then, does sustainable development apply to countries? The cold language of the banker is often used to describe sustainable development. Natural resources are said to be "national assets" to be "managed" like a long-term "bank account." Even if uncontrolled logging, over-use of agricultural land, emptying of aquifers for irrigation, over-fishing of waters and so on may temporarily increase national income, they represent "borrowing" against the future. Natural resources and development must be kept in "balance" for the best long-term "pay-off."

Protecting natural resources for development is indeed an investment. A cautionary Swahili proverb sums it up succinctly: "Do not borrow from the earth, for the earth will require its own back with interest."

Daily Survival

It is not just harried government officials, international corporations, export-minded elites and urban-oriented planners who degrade natural resources. Damage results from the slash-and-burn agriculture on marginal lands by poor campesinos in Central America, the destruction of small trees for fuel for cooking by African women, the over-use of ground water by expanding populations in the Middle East, the fishing with dynamite in Asia.

A range of quick solutions used by desperate people takes its toll on the environment. "Farmers and nomads faced with the requirements of daily survival," noted Hassan bin Talal, Crown Prince of Jordan, "may have no choice but to further destroy their vital environment."

Now, however, the destruction has reached a point that people and their leaders see themselves immediately threatened. "Saving tropical forests is no longer a luxury, but a priority for Africa as a continent...[Unchecked deforestation] may result in economic disruption, political instability, famine, drought and disruption of our basic life support system," warns Kenyan Minister for Environment and Natural Resources Jeremiah Nyagah.

Similarly, Yemeni officials note with alarm that the introduc-

tion of modern pumping systems threatens to exhaust the ancient and irreplaceable water held by the underground layer of sandstone of the Sanaa Basin aquifer. "With drilling machines, everyone believes they will reach an underground ocean, but we don't have one," cautions Mohamed al Fusail, head of the National Water and Sewage Authority. "All we have is a very old aquifer."

Many farmers have developed techniques that do not degrade the land.

New Optimism

Can Third World countries—burdened by rapid population growth, landless peasants, unemployed urbanites, limited resources, foreign debts, insufficiently trained managers, unmet popular demands and a host of other pressing problems—really avoid mortgaging the future to survive the demands of the moment?

Surprisingly, an increasing number of experts believe the answer is *yes*. The optimism is based on four basic considerations:

First and foremost, people are demanding environmental safeguards. (People want to be sure that the water they drink, the air they breathe and the food they eat are safe and unpolluted.)

Second, Third World leaders are starting to address sustainable development at the local level.

Third, the leadership of the worldwide sustainable development movement is shifting to the Third World.

Fourth, more and more Third World nations have adopted population policies and programs to synchronize growth rates with economic and environmental considerations.

Around the world, trained experts find astonishing examples of small landholders who have worked out highly complex farming techniques to maintain harmony with their natural surroundings. Sustainable development of renewable resources is an old concept. Can it be revived on a large enough scale to put man and his environment back into some kind of sensible balance? Or is **Child 5-Billion** condemned to live a blighted existence in a decaying environment?

"The Challenge of Our Times" was written by Winthrop P. Carty of the Population Reference Bureau, 1989.

"Until the last few years, Africa regarded environmental concern as an American and European matter. Indeed, there was a tendency to believe that talk of the environment was part of a conspiracy to prevent modern development on our continent. Now we have reached the stage of recognizing that environmental concern and development have to be linked together if the latter is to be real and permanent."

Julius Nyerere, former President of Tanzania

Sustainable Development in Africa

If there was any doubt in anybody's mind that Africa faces a severe crisis in its ability to sustain development, the recent floods in the Sudan and the resultant famine come as a grim reminder. The Sudanese floods also underline the fragility of African ecosystems and the primary economic structures that have been built on them.

Africa

The floods in the Nile plains of Sudan and the devastating drought of northern Ethiopia are in fact dramatic alarm signals, omens of what could be the fate of much of the rest of sub-Saharan Africa. There is little the world can now do for these two regions except to pump in humanitarian aid and attempt to fix up the crumbling ecosystems. The damage done to the land's ability to sustain life in northern Ethiopia, parts of the Sudan, the Sahel and many other areas of Africa is permanent. These areas have become deserts. They are no longer habitable. The huge numbers of people who used to live in these areas have been forced to move after millions of their compatriots died the most tragic deaths.

The Major Problems

The two major problems facing Africa are desertification and the population explosion. Both feed on each other to create the nightmare scenario for Africa's future. They are man-made rather than acts of nature. Because of this, there is hope—what man can do, man can undo. Desertification can be checked and the population explosion can be curbed. But before the problem can be tackled, it is necessary to define it in simple and clear language.

Desertification

All cultivation, including grasses for cattle and sheep fodder, depends ultimately on a thin layer of topsoil. It is the biological interaction of all the components found in topsoil—moisture,

animal life (bacteria, worms and so on), chemical compounds and a variety of carbons released by decaying matter—that provides the nutrients for plants. It is on this plant life, either as cultivated crops, or trees and bushes or grasses, that man survives. As long as the plant cycle is maintained and nutrients are returned to the soil, the soil remains fertile and the cycle remains intact. Upset the balance, however, and remove more from the soil than you return and the soil becomes impoverished. It is like dipping into your bank balance without depositing any more money. Sooner or later, the soil becomes barren, just as your account runs out, and from this point on, you are borrowing. When the soil becomes exhausted, that is, when all the nutrients have been removed—nothing will grow. This is desertification.

Unlike a bank balance, which can be revived with a sudden deposit of cash, an exhausted soil remains dead. A soil is fertile because it is "live," because it is a miniature world with interdependent components. It often takes millions of years for a soil to build up to its special consistency. When the balance of the soil is upset, each of its components begins to die out and the rich, fertile soil turns into wasteland. Desertification.

One area of desertification, like a cancerous growth on the skin, will spread to other areas and soon the true desert will begin to encroach on once healthy land. In Africa, the desert is spreading and unless it is checked, it will swallow up most of sub-Saharan Africa.

Hectare
1 hectare = 2.47 acres
Kilometre
1 square kilometre = 0.386 square miles
210,000 square kilometres is about the size of Kansas.

Desertification is not confined to Africa—it is a global problem. Every year, 21 million hectares of land (210,000 square kilometres) are degraded to the point of no economic return and a further 6 million hectares are turned into desert.

Desertification already affects some 35 million square kilometres of land world-wide and of this, almost a quarter is in Africa. Studies from the United Nations Environment Programme show that most of Africa's rangelands and rain-fed croplands are at least moderately affected by desertification and 30 per cent of Africa's irrigated lands are

World Areas Threatened by Desertification

similarly affected. This means, in effect, that over 80 per cent of the continent's available farmland and rangeland has already lost a significant part of its productivity, and the process is continuing and accelerating.

What Causes Desertification

The soil and its condition are part of a group of an area's natural factors—the ecosystem. Nature's wonderful mosaic of life-forms and inanimate objects evolves over millions of years and is designed to sustain life, including human life, on a continuous basis.

All ecosystems are complex, and the balance between all the components—the flora, the fauna, the composition of the soil, the water-table, the amount and seasonality of rainfall, the rivers, the cloud-cover, the amount of sunshine, the temperature and the altitude—is finely tuned. Upsetting this balance in any way affects all the components and could lead to an ecological disaster.

The most dramatic manifestation of the crisis in Africa is the on-going drought in the Sahel, Ethiopia and Sudan. The result has been the death of millions of people and the almost total destruction of their herds. The long-term effects mean that these areas, which once supported several million lives, are now barren, the land totally degraded and capable of supporting nothing.

Droughts in themselves do not cause desertification, but drought, in conjunction with other factors that degrade land and the environment, accelerates the process of desertification. Degraded land itself conspires to create drought conditions, which in turn worsen the damage.

Despite the harsh lessons of the Ethiopian famine, land degradation in Africa continues at a faster pace than at any other time in the continent's history.

How Land Can Be Degraded

The main causes of land degradation in Africa are the following: over-cultivation, over-grazing, deforestation and one of the most massive population explosions ever seen. Each of these factors occurring by itself would lead to severe environmental and economic problems; the combination of all four occurring simultaneously, with the added threat of cyclic droughts, points to a major catastrophe.

Too many cattle grazing on a small plot of land is one cause of land degradation.

In the old days, before national boundaries had solidified and when the population of Africa was much smaller, the traditional methods of shifting cultivation allowed land to remain fallow for extended periods of time. This allowed the land to regenerate, and the droppings from the small herds of animals provided sufficient fertilizer to sustain a reasonable level of cultivation. Given small, scattered communities, the collection of twigs for fuelwood did not adversely affect the forest. An adequate plant cover stabilized the water cycle and therefore local rains were much more predictable. Plant cover also performed the vital task of knitting together the soil and preventing large-scale soil erosion.

Herders and nomads had vast areas over which their cattle, sheep and goats could roam, and again the fertilizer from animal droppings ensured a steady, continuous supply of animal fodder.

Over the past four decades, however, this scenario has changed completely and dramatically. Since 1950, Africa's population has tripled. At the same time, national and local boundaries solidified, thus preventing traditional nomadic movements from area to area. In addition, the need for foreign exchange meant that large tracts of fertile land were put under cash crops, and the former farmers of these areas relocated to either marginal lands or squeezed into already over-crowded areas. The spread of large-scale plantation farms also pushed millions of peasants into smaller holdings, with little room to rotate crops.

Whereas many Africans, especially in eastern Africa, used to own land communally, the introduction of land-ownership and title deeds meant that shifting cultivation could no longer be practiced, and lands were parcelled out permanently. Hence, whereas in the past sons would be encouraged to bring new land under cultivation, now they are forced to farm on land they inherited from their parents. The land then gets divided and passed on to their children. By the third generation, the plots of land received by each child are not only minuscule but are often

infertile. Succeeding generations from the same family find it more and more difficult to support themselves on their small plots of land. They quite often abandon the now degraded land to look for jobs in the cities. Here they join the ranks of the unskilled unemployed and are often forced to live in crime-infested shanty towns.

Peasants on lands that are no longer sustainable tend to move into available virgin territory, burning down trees and vegetative cover to start new cultivation. The extensive manual labour that is required in breaking and cultivating new land encourages the desire for more children. But more mouths to feed causes more intensive cultivation of the same parcel of land. Wood for fuel and building, estimated in Africa to run to one ton per person per year, leads to mass deforestation. This upsets the water cycle leading to irregular rainfall. When it does rain, usually torrentially, there is no plant cover to prevent the massive soil loss.

All these factors combine to severely degrade the land, producing smaller and smaller returns for a population that grows larger and larger. As more and more areas become unproductive and more and more forest cover is cut down, either for fuelwood or cultivation, conditions for prolonged drought are encouraged. As fuelwood becomes scarcer (in Ethiopia and part of eastern Africa, women often have to walk 15 to 30 kilometres to obtain fuelwood), dried cow dung becomes the preferred form of fuel. Cow dung has now acquired considerable commercial value and fetches a good price. This means that there is very little cow dung available to use as fertilizer. This degrades not only cropland but has also impoverished vast tracts of rangeland.

Without moisture in the soil and

Transfers of More Appropriate Technology

The developing world should be cautious about accepting agricultural technology transfer from the industrialized world, according to a paper presented by Mohammed El-Ashry and Jeffrey Gritzner of the Washington-based World Resources Institute.

"Indiscriminate transfer of technology from temperate zones to tropical regions has seriously accelerated soil erosion and the conversion of forest into grass-savannah and sterile steppes."

Even accepted technologies of improving agricultural production are now called into question. Large-scale irrigation used to be considered a trouble-free way of raising food production. But now experience in the Sudan and other countries indicates that irrigation projects increase salinization and water-logging and increase health problems. In one area of the Sudan, irrigation brought a 267 per cent increase in malaria cases and a 77 per cent increase in bilharzia, both water-borne diseases.

Over the last 20 years, sustainable development has often meant incorporating new "miracle" grain varieties and piling on expensive fertilizer. High-yield grains and fertilizers are often too expensive for poor farmers. In addition, the use of large amounts of pesticides and chemical fertilizers can damage the environment. Now research institutes are turning their expertise to staple crops like yams. They are pioneering "biological pest control." In a remarkable breakthrough, the International Institute of Tropical Agriculture in Nigeria has propagated and distributed a small parasite that feeds on the mealybug, which devastates cassava crops throughout Africa and Latin America.

with very little coming in the way of animal by-products as fertilizer, huge tracts of rangeland in Africa, from the Sahel to Lesotho, are churned into dust by the hoofs of animals as they travel vast distances in search of grazing lands.

In many areas such as northern Uganda, Somalia, northern Kenya, Senegal, Mauritania and northern Nigeria, nomadic communities looking for grazing land are coming into conflict with agricultural communities. There have been several instances of open warfare between the two modes of life, and thousands of people have been killed in feuds.

The immediate problem of deforestation can be partially checked by better farm management and reforestation programmes. But, the key factor remains the population problem. Unless Africa's population explosion can be checked, all environmental and agricultural programmes will be like weak mud dams against the rising flood of an environmental catastrophe.

Table 1

World Population: Number of Years to Add One Billion People

	Year	Years to add
First billion	1800	all of human history
Second	1930	130
Third	1960	30
Fourth	1975	15
Fifth	1987	12
	Projected	
Sixth	1998	11
Seventh	2008	10
Eigth	2019	11

Source: Population Reference Bureau

The Population Explosion

It took millions of years for the population of the world to reach 1 billion (around 1800), but since then it has been increasing very rapidly (see Table 1). Each billion has taken fewer and fewer years to be added. It is thought that the population of the world will surpass the 6 billion level by the year 2000. Africa has the highest population growth rate in the history of man. Africa's population was estimated at 222 million in 1950 and 661 million in 1990. It is expected to reach 800 million by the year 2000. This is a staggering statistic, showing a growth rate of between 2.8 per cent and 3.0 per cent per year with a peak of 4.2 per cent in Kenya, which has set the world demographic growth record.

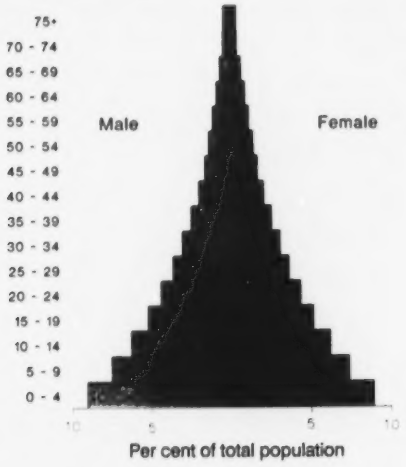
Although the population of the world increased dramatically over the past 30 years, the rate of growth slowed in the industrialized countries after the baby boom that followed World War II. In Latin America and Asia, the population growth rate increased to 2.9 per cent per year in the 1960s, but has now stabilized at around 2.2 per cent and shows signs of further decline. Africa has been the only exception to the rule with the population growth rate going up rather than down.

A study by the United Nations Food and Agriculture Organi-

zation shows that Africa has the resources to feed its expanding population, but this can only be done if people from highly populated areas move into the less populated areas of Africa. Given the rigidity of national boundaries, people's reluctance to move to foreign lands and the time lag that will be required before an alternative sustainable system is set up in the new areas, it seems certain that mass migration will not occur to ease the burden of a burgeoning population on lands that are already reaching dangerous levels of degradation.

At present, food production in Africa is increasing at an annual rate of 2 per cent, whereas the population is increasing at about 3 per cent. The deficit is largely made up of imported or donated food. If present trends continue, Africa will only be able to feed itself by continuing to increase its food imports (at present it imports roughly 25 per cent of its grains). In order to do this, it will have to increase its output of cash crops with which to pay for the food and this will reduce the amount of arable land under domestic food cultivation, leading to further deficits.

Figure 1
Age Distribution: Africa 1990



Source: World Bank

Because 40 percent of Africa's population is under age 15, Africa will experience continued high population growth for many years.

Causes of the Population Boom

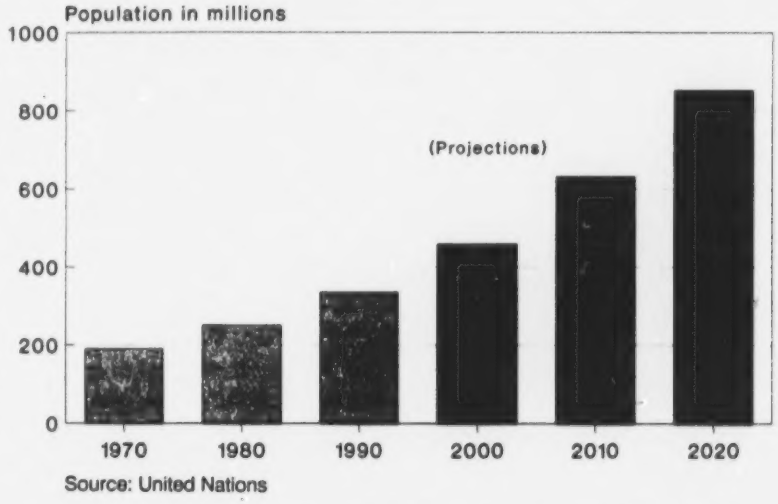
Why has Africa's population grown so rapidly over such a short period? There are no simple answers, but the most common cause is the advance of medical facilities resulting in the survival of many more babies than before. The death rate is down and people are living longer. Normally, lower infant mortality leads to smaller families because parents do not feel the need to produce many children to ensure that some survive. However, the momentum of the earlier desire for many children, reinforced by custom and the tradition of women (a woman's status in society is determined by her ability to bear children) has overlapped with better health care. As a result, many more children are born and survive.

Children are also useful for labour in peasant societies where farming can be back-breaking and the increased destruction of land can mean more difficult and therefore more labour-intensive work. Parents also look upon children as a comfort in their old age when they are no longer able to work. The more children they have, or so is the belief, the greater the chances that some of them will care for their parents.

With the trend towards city life and city jobs, parents often feel that one or two of their children will succeed in the towns. The other children are often used to provide labour to fund the education of the "bright" children.

In practice however, a large number of children often leads to poverty and an increasing splintering of the family plot. As a consequence, many teenagers drift to the urban centres to look for employment and swell the shanty towns and slums. Here, unfettered by tribal customs, girls often undergo unwanted pregnancies. The rate of population growth in African cities is a staggering 7 per cent.

Figure 2
Labour Force Growth (Population ages 15-64): Africa 1970-2020



The size of Africa's labour force population will more than double by 2020. The economy will have to grow tremendously to support the growing population.

In many African countries, this pool of unemployed youth is used by criminals and by unscrupulous politicians to cause social disorder. In the countryside, the growing young population is often drafted into "people's armies," as in Uganda and Sudan, and made to fight wars of which they have little understanding. One result of these bush wars, as in Mozambique and Angola, is that agricultural production is often severely disrupted and millions of people are displaced.

African governments, faced with this huge increase in the population, find their resources stretched to the limit. Forty to 50 per cent of people in many African countries are under 15 (see Figure 1), and these countries will be fully stretched in providing basic health care and education for all their new citizens. The economy will have to grow at least 15 per cent each year to even hope to provide jobs for Kenya's growing labour force (see Figure 2).

What Can Be Done?

The major problem in Africa is not that its population is expanding but the rate at which it is expanding. At present, Africa

The education of girls leads to a desire for smaller families.

has nowhere near the resources needed for its expansion and the solutions in the long run have to be two-pronged: The population explosion has to be curbed and new technologies have to be introduced to increase the per capita production both in food and other products.

A vigorous and committed family planning programme in which the government, United Nations agencies and various other nongovernmental organizations are involved promises the only viable solution to the population crisis. The first task is that of education. This is a sensitive issue as it involves reducing fears and prejudices, particularly if the government is dominated by one tribal grouping and is seeking to introduce family planning to a rival grouping. These are real issues in Africa and must be acknowledged as such if real progress is to be made. Political infighting and suspicion often cloud the population issue and therefore the whole subject will have to be approached with tact and understanding.

However, it is encouraging that as women receive more education and increase their earnings, their desired family size is reduced. In eastern Africa, the majority of educated women now wants only five children compared to the average desire for seven or eight children.

It is also very encouraging that African governments are now committed to relating demographic growth to development strategy and the example of Kenya's lead in family planning campaigns should be applauded.

Condensed from an article written for the "Global Edition" by Anver Versis. This article first appeared in the New African, *London, England, February 1989.*

The Connection Between Poverty and the Environment

News of environmental disasters and looming dangers related to the destruction of the environment have become more and more common in recent years. The Secretary General of the Commonwealth of Nations argues that, for developing countries, poverty lies at the heart of the apparent "wanton" destruction of

the environment. "Sustainable development calls for major decisions which are in themselves dependent on the international socio-economic climate. The argument continues that where a small elite controls the production base, land tenure is skewed and growth bypasses the poor."

Poor people often destroy their own environment not because they are ignorant but simply to survive. They over-exploit the soils, over-graze fragile grasslands and cut down dwindling forest stocks for firewood. But in the short-term context of meeting the needs of an individual, each decision is rational; in the long-term and wider context the effects are disastrous. Poverty is both a cause and effect of environmental degradation.

The environmental problems of Africa and the rest of the Third World are interlinked with what happens elsewhere in the world. The developed countries consume 80 percent of the world's commercial energy, 85 percent of its paper and over 50 percent of the fat content of foods.

It is an integral part of the environment and development connection that we live in a world in which rich countries have already drawn much of the world's ecological capital and continue to dominate the international economy. Those resources have an environmental base.

The greatest handicap for Africa is sustainability. The environmental base is limited and ways must be found to enhance progress by meeting the needs of the present without compromising the resources for future generations. But even the best efforts of developing countries will fail without massive external help and a more just and better managed international economy.

The priorities and responsibilities in Africa must be to slow population growth below its current high levels, to help the small family farmer become more productive, and to help develop renewable energy sources that can be developed without much outside aid.

But it is wrong to think that reducing population will decrease poverty. Only the efficient use of local resources, much of which will be used to provide the basic needs for a youthful population, can create the much sought-after wealth.

Condensed from an article written for the "Global Edition" by Abel Ndumbu. This article first appeared in Development Horizons, *Nairobi, Kenya, February 1989.*

"In the developing world..., we realize that the main problem we have is that we do not have employment opportunities, and most of these people who are unemployed move from rural areas and they migrate into the cities and those who remain behind always indulge in processes—for example, charcoal burning—and all this leads to deforestation."

Kennedy Njiro, Kenyan student

Survival in the Sahel

To survive—"To make ends meet," as Saadi Ibrahim said—has actually become the basic daily issue for large segments of Sahelian populations.

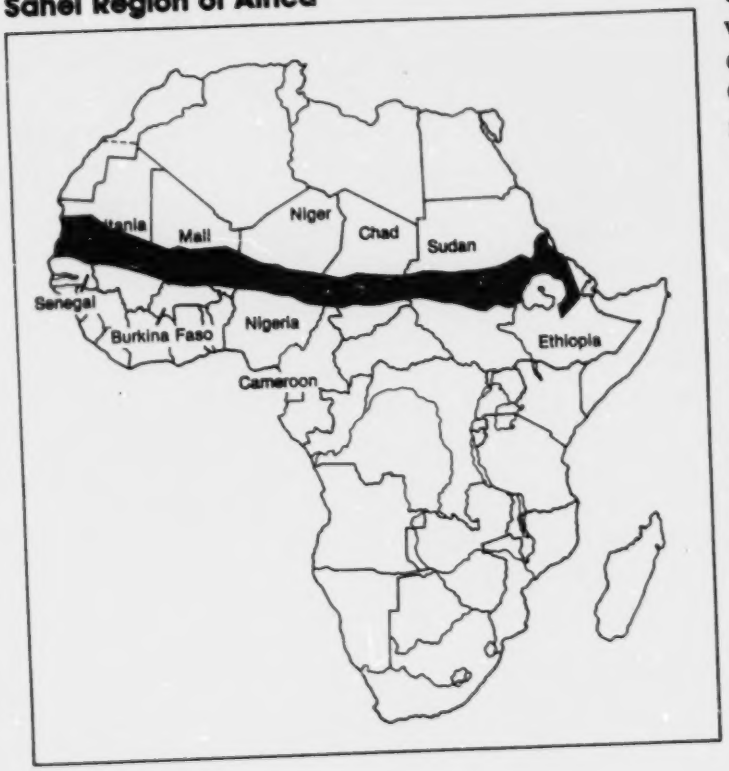
When the judge in Tahoua, Niger, asked Saadi Ibrahim if it was true she had killed her newborn infant, the 27-year-old woman voluntarily pleaded guilty: "It is true, your Honor," she said. "I admit I perpetrated the crime of infanticide."

The presiding judge: "Why did you kill this infant?"

Saadi Ibrahim: "Your Honor, I did it because I would have been unable to bring her up. I do not have any help and I always have been in a desperate situation."

The child Saadi strangled was born a year too soon to be **Child 5-Billion.** However, the dramatic living conditions that encouraged the mother to put an end to the life of this unfortunate newborn may foreshadow the conditions in which the five billionth inhabitant of the planet may have to live if he or she was born in one of these nine Sahelian countries: Burkina Faso, Cape Verde, Chad, Gambia, Guinea Bissau, Mali, Mauritania, Niger or Senegal.

Sahel Region of Africa



To Survive at Any Cost

Over the last decade, the combined effects of drought and desertification on the environment on one hand and economic underdevelopment on the other have exerted a pressure for which the Sahelian population is unprepared. Poverty has spread. It now affects all social classes in the Sahel region, from the most remote places to state capitals and large cities.

In urban centers, sharp increases in the price of basic goods, an extremely high unemployment rate, low salaries, pitiful living and health conditions, lack of health care as well as a high population density have led to a frantic and always

renewed quest for cash. Life has lost its meaning and basic values, encouraging in turn delinquency and decadence.

In rural areas, the accelerated deterioration of the environment, the depletion of soils, the uncertainty of agricultural production, the loss of cattle due to drought and the large number of people leaving rural areas have led to a noticeable breakdown of basic social order. Farmers migrate, shepherds settle and women, children and the elderly are abandoned. To survive—"To make ends meet," as Saadi Ibrahim said—has actually become the basic daily issue for many Sahelians.

The survival of populations in the Sahel region is directly associated with the scarcity of food and the acceleration of environmental degradation.

At the beginning of this century, the Sahelian countries imported only 1 percent of the grains needed to feed their people. Sixty years later, when independence was declared, imported grains represented about 4 percent of household consumption. It has now tripled to 12 percent. This volume is expected to continue to increase in the years to come.

Overworked and Fragile Ecosystems

In 1990, the total population in the nine Sahelian countries was estimated at 42 million. The population grows at an annual rate of about 3 percent. At the same time, the amount of arable land declines on a regular basis because of the spreading desert. This decline in farmland proportionally affects food production.

The decline in arable land, rapid population growth and the deterioration of climatic conditions mean that much of the population is uncertain of the source of their next meal. This is the reason that many are chronically malnourished.

This decline has proved to be catastrophic for the Sahel. "The 1968-1973 droughts," Abou Thiam wrote, "probably caused the deaths of 100,000 to 150,000 people in the western African States alone (Burkina Faso, Mali, Mauritania, Niger, Senegal and Chad) caused by the resulting famine. In fact, after-effects were felt well after the drought because farmers who had used up their seed supplies to survive, were only able to sow their crops after the rains started falling. Thus, in 1974, about 250,000 people in Mauritania and Mali (respectively 20 percent and 5 percent of the total population of the country) and 200,000 in Niger were totally dependent on food assistance."

Migrants fleeing drought in Africa. Natural disasters tend to push people toward the cities.

At one point, emigration was one of the ways people escaped the pressure from natural scourges. This is still true today despite country borders. Also, people tend to move to the south where there is more rain or they move from rural areas to the cities. This migration resulted in a loss of people from the regions most hit by the drought, rapid population growth in the cities (6 to 10 percent annually in Sahelian cities), higher population density in the southern regions of the Sahelian countries and an increase in migrations toward countries located on the coast of the Gulf of Guinea (specifically Côte d'Ivoire) and other continents as well.

Migrations, malnutrition and famine encourage the spread of diseases, whose disastrous results are often overlooked. Refugee camps, ghettos, and private welcome centers for the "hunger migrants" are centers for devastating endemic diseases.

Desertification

If the drought is not the direct cause of desertification, which threatens all of the Sahel region, it undoubtedly worsens and prolongs the effects. Desertification is defined as a process that leads to the decrease in the biological potential of arid and semi-arid zones. This process usually hits fragile ecosystems that have been overworked. Recurrent droughts also contribute to the problem.

Overuse of the ecosystems by humans opens the way to the progressive dwindling of plant life cover, followed by the erosion of soils and the loss of soil fertility. Man's destructive action takes place in three ways: the use of wood as fuel, the clearing of land for farming purposes and overgrazing. "In the Sahel," Abou Thiam wrote, "between 60 and 90 percent of domestic energy needs are met with the use of fire wood and charcoal. In many of these regions, the wood shortage ranges from 42 to 80 percent of the available production. This shortage is often remedied by exploitation of the available forest."

In most of the Sahelian states, the 1988 rains were plentiful. Ever since the last drought in 1984, everyone had been expecting this clemency from nature. But when the rains finally came, they generated a number of problems, like floods and swarms of

grasshoppers, for which the inhabitants of the Sahel were unprepared. In Burkina Faso, 10,000 people were affected by floods and over half of them lost their homes. In some provinces, emergency food distributions were impeded.

The rains have promoted a rapid reappearing of plant life, making the land ready for a grasshopper invasion. In Niger, grasshopper swarms have devastated about 47 million acres. A swarm that covers a 4,306 square foot area can consume up to 88,000 metric tons of plant life a day.

This year's invasion, the worst in Sahelian Africa in 30 years, led a specialist to say: "It is impossible for the African farmer to win. When it does not rain, his crops die out. When it finally rains, the grasshoppers appear."

One Goal: On the Way to Sustainable Development

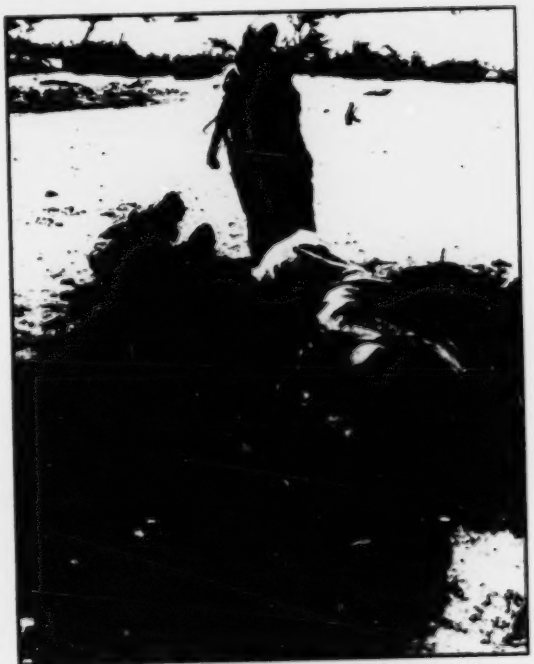
After a warm wind, nature seems to be blowing a cold wind and the Sahel appears to be caught in a huge vicious cycle of natural disasters.

A serious change in the environment, the inadequacy of development policies, the irregular rate of exchange and the excessive pressure caused by the external forces, economically choked the Sahelian countries and destroyed any effort toward development.

Should the Sahel regions have no hope for their future? Will Sahelian women be forced more and more to give birth in a remote area in the bush and strangle their newborn infants, as Saadi Ibrahim did? Can the profoundly fatal trends caused by climatic changes be compensated? Is a recovery possible?

Sahelian governments are becoming more conscious of the urgency in finding solutions to the population's problems. At the same time, more and more government officials are paying attention to the need to preserve the natural environment in the Sahel region in order to carry out a balanced integration of the needs of a growing population within a sound framework in development planning: sustainable development.

This on-going economic and social progress is the overall goal. It can not be achieved if one or more



Small successes, such as this garden, give hope for the future.

of the factors, vital to the development process, is neglected. The problems associated with population growth and the requirements for the environment must be taken into account on an equal basis with economic growth.

Adapted from an article written for the "Global Edition" by Aliou Diongue. The original French version appeared in Pop Sahel, *Bamako, Mali, May 1989.*

Artificial sand dunes are effective barriers against the movement of sand.

Kenya
Part 1 From Birth Control to Population Management

For some people, family planning forms the subject of lengthy debates, provoking heated arguments that run for hours on end. For others, it is taboo, only to be discussed in private.

In the capitals of developed countries—Washington, Paris, London, Brussels—family planning is top priority for development assistance to African countries. But for most civil servants charged with the responsibility of population management, the problem is so complex that it has continued to defy solution.

Kenya

Kenya's high population growth rate, one of the fastest growing among the developing countries, has undergone changes. From 8.5 million at the time of independence, the population increased to 10.9 million by 1969 and continued to rise to nearly 25 million today.

The 1979 census put the growth rate at 3.9 per cent. This has been a contentious issue, with different authorities and officials giving figures ranging from 3.6 to 4.1 per cent and local demographers insisting that the other experts—both foreign and local—are exaggerating the figure to attract development assistance. Current estimates put the growth rate at 3.8 per cent and few people would argue that a population problem does not exist. The approaches to population have varied from one end of the spectrum to the other in eastern Africa.

Before independence, the colonial government, for reasons considered "not so honorable"—to maintain a cheap, plentiful supply of manual labour—announced a policy that said: "We are not of the opinion that the rate of natural increase is such in East Africa as to warrant any large-scale attempt to introduce these methods with the object of reducing the birth rate for general economic reasons." The colonial government was reacting to pressures of a planned-population approach to development.

Since independence, Kenya's government, perhaps more than any other government in Africa, has been attempting to get a grip on the problem. A population council was founded to coordinate all family planning activities. The government was reacting to the many agencies that had cropped up in the family planning field.

Government policy-makers have been cautious not to appear to want to control a most personal area of life. Family planning has received official allocations of funds in development plans but the emphasis has always been on improving the standard and quality of life.

Those charged with the implementation of the population policy point out that at the current rate of population growth and depletion of resources, it is no longer desirable to handle the problem with kid gloves. The need has arisen to awaken serious consciousness so that the capacity to have children is matched with the capacity to take care of them.

The majority of people at whom the family planning programme is aimed have always known life at the bottom and cannot understand why anybody should think life will be better with fewer children. It is important therefore to have a policy. That, Kenya has. It is also important to have family planning supplies and personnel; these are available for Kenya. Practically every childbearing couple has heard a family planning message. The question is: "What do they do about it?"

"...the population explosion can pose a national problem and even lead towards catastrophe."

Daniel arap Moi, President of Kenya

There is a large number of women in the rural areas who are already having several children. They are a determined lot; they say openly they will continue to give birth for as long as the children keep coming. For them and their husbands, family planning—by whatever name it is called—is a curse. Children, as many African scholars know, are an asset, a kind of insurance, to take care of parents in old age.

For this group, programme success depends on spending on items that improve the quality and standard of life: irrigation schemes to enable the rural areas to become integrated into the economy; improved agriculture to retain topsoil and achieve higher yields; building of health centres and clinics; construction of roads to ensure smooth links with other areas; creation of more jobs; and improved cooperatives and other activities that help them put money in the rural areas in the pockets of local people.

The group with which the family planning message has most success is working mothers who already feel the pinch of the rising costs of living and see their purchasing power diminish over the years. Indeed, the majority of working women practise some method of birth control.

The strong arguments against the use of some of the technology and drugs create impediments in the acceptance of family

planning. Importantly, the question continues: "If they have banned the use of those gadgets and drugs in Europe and the United States, why should they be dumped upon Africa?"

Men as a group are the most averse to any methods of birth control. Apart from a general reluctance to accept birth control measures aimed at men, a macho culture has persuaded spouses to insist that "the act" be performed without the encumbrance of technological equipment. Family planning is still very much a female affair.

The group with the largest potential for acceptance of family planning methods is the youth. But in a society where most schools have affiliation to a religious denomination, public morality plays havoc with the programme. It has been suggested and more or less accepted that to prevent unwanted pregnancies family planning should become part of the school curriculum. No one, however, seems willing to take the initiative of developing the curriculum and deciding what information would be offered to girls and boys for fear of being accused of introducing promiscuity.

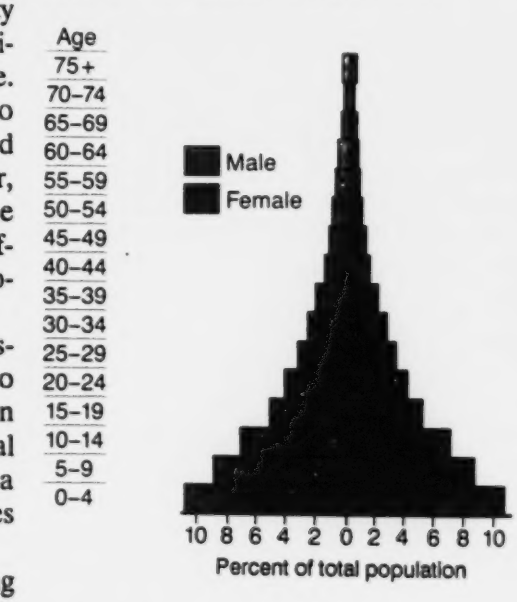
The idea among programme staff is to use the assistance of modern technology to bring the birth rate to manageable levels within a period shorter than that taken by the industrialized countries. It has not been lost to local observers that population experts who come to Africa may not be more than salesmen of birth control devices made in their countries.

Some Kenyan gynaecologists complain of waiting lists of women for birth control facilities while money is spent on "useless seminars" and offering service to rural women who have already rejected the idea of birth control. The same doctors and fellow demographers have little respect for population expatriates who push development assistance money from their countries and establish posh offices in the cities where they "live big," while the real problems remain untouched.

Indeed as the debate on population management continues, there has been a creeping fear that solutions and population programmes have been dictated by aid donors and their desire to export equipment rather than by the felt needs of the people. Hence local demographers insist that attempts—from whatever quarter, particularly external—to impose population programme

Figure 1

Age Distribution: Kenya 1990



Source: World Bank

Family planning helps ensure children's health and well being.

modes on Africa should be accepted with a measure of healthy suspicion.

They also point to the disasters that followed forced sterilisation in India for some time, and the damage done by the carrot-and-stick methods of rewards for smaller countries in Asia.

When all is said, however, Kenya is the first among a handful of African countries to acknowledge a population problem and devise a policy to deal with it. President Daniel arap Moi has consistently said that although the issue is always regarded as a personal domestic matter, the government may be forced "to step in" if it goes on unabated because the "population explosion can pose a national problem and even lead towards catastrophe."

Part 2 Fuelwood and Population

In a sleepy village near a low-lying, semi-arid area of Kenya, a young man wakes up every morning to go to work. Work for him involves cutting down trees for charcoal. In recent years he has had to travel farther and farther afield in search of suitable trees.

Mutisya, 18, dropped out of school early. His education was insufficient to get him a white-collar job. He had learned no useful skills necessary to earn a decent living. His father owned only a few cattle and some goats. He was no help. As if by predestination, young Mutisya was set on a collision course with nature....

In Nairobi's Dandora Estate, Mama Wangui fans a charcoal stove to a crackling blaze. The day's dinner will soon be underway. Innocently, she is a link in a vicious circle that starts many miles away when Mutisya puts his axe to a Muuki tree, one of the last of that hardy species.

In the Tawa area of Machakos District, the Muthata tree, a species that takes 50 years to mature, once abounded. Today, it is very rare, a victim of the ubiquitous charcoal burner. Environmentalists fear that in 20 years the species may be extinct in Machakos. This will lead to a double tragedy: extinction of precious tree species and exposure of the topsoil to erosion.

The same fate faces the Mwanjati tree in Nyandarua district in Kenya's central highlands where the slash-and-burn brigade daily cuts it down in the thousands to feed fuel hungry charcoal stoves as far away as Kisumu to the west and Nairobi to the south.

Many trees face extinction as Kenya's rising fuel needs are not matched by an equivalent increase in the sources of fuel. An accusing finger is pointed at rapid population increases.

What these trees have in common is that they make high-quality charcoal, have a poor self-propagation rate and take many years to mature. The high demand for charcoal from such trees means that they cannot be replaced at the rate they are cut down. Some trees take between 15 and 20 years to mature. "It takes five minutes to chop down such a tree," says the director of the Kenya Woodfuel Development Programme. "You can imagine the consequences on the environment."

Charcoal from Machakos and Kitui, two marginal districts, is much sought-after. The two districts demonstrate the seeming capriciousness of nature. The rainfall and soil conditions are such that trees take a long time to mature; poverty is rampant due to those very reasons. Therein lies the recipe for disaster. And in the last few years it has been encroaching like some dark ominous cloud. Poverty leads to the cutting down of more trees, which leads to desertification and soil erosion, which leads to more poverty. The topsoil is exposed with the attendant dangers of soil erosion; lack of tree cover exposes the ground to heat, endangering vital micro-organisms; the soil is robbed of humus; watersheds are destroyed, resulting in surface runoffs and desertification.

Charcoal burning is a case where it is easier to make a diagnosis than to prescribe a cure. It is easy, for instance, to condemn the Kitui charcoal burner as an unfeeling environmental rapist. It is equally easy to point out to him the dangers to which he is exposing his area's future. But it is much more difficult showing him alternative sources of income.

To many charcoal burners in Kitui and Machakos, their occupation is vital. In times of drought—which is most times—the land will simply not yield, and between money and starvation are a few skinny cows and goats. Is it any wonder then that, to them, the trees seem to invite the axe?

The realities of the situation also place the authorities between a rock and a hard place. On the one hand, charcoal burning and selling provide jobs for many who would otherwise be unemployed; a total ban would be unthinkable. On the other, un-

"Fuelwood and charcoal are, and will remain, the major sources of energy for the great majority of rural people in developing countries. The removal of trees in...African countries is a result to a large extent of increasing energy needs from an increasing population, both rural and urban. The most visible results are desertification, soil erosion, and general environmental degradation. The reasons behind these disappointments are many, but a central cause is undoubtedly a singular focus on trees as the object of attention, rather than people. Forestry must enlarge its horizons: beyond trees—to the people who must exploit them."

Rutger Englehard,
Beiger Institute's Centre
for Energy and Development
in Africa

Trees are cut to provide charcoal for energy.

checked slash-and-burning would be suicidal.

This situation has given rise to all sorts of innovations, from the much publicized Waclaw Micuta "ico" (stove) of the 1970s promising an almost miraculous cure to Kenya's fuel problem, to the much-extolled virtues of biogas. But apart from chipping away at the edges of the problem, these innovations have had no dramatic impact.

For a tantalizing moment it seemed as if the Sahel, said to be marching inexorably downward, would be checked in its stride once more and for all by biogas. Experts calculated that with rural Africa so populated by livestock, dung energy would be available for all. However, it became apparent that ownership of livestock was not so widespread after all. Moreover, it soon became clear that the components were so expensive—costing about US$1,200 to install a biogas plant—that only the rich could afford them.

Energy-starved Kenyans next turned their eyes hopefully to solar energy. A small gadget fixed on the roofs of their houses, they heard, would light their homes, fuel their stoves and meet most of their other needs. But as with biogas, solar energy has proven to be unattainable to the majority of Kenyans. It is too expensive for the majority who earn less than $100 a month.

That leaves paraffin and liquified petroleum gas as the only viable alternatives to charcoal, especially in urban centres. These have their shortcomings. Paraffin is costly and shortages occur at awkward moments. A gas cooker is expensive to buy and therefore a luxury to low-income people. Pending a breakthrough in the use of energy, charcoal will remain for many people in Africa the most convenient fuel. This is evidenced by its demand.

Recognizing that condemnation alone will not work, the government, other organizations and environmentalists have been working on fuel conservation measures leading to the production of a number of energy-saving stoves whose rate of acceptance has been rather slow.

On its part, the Ministry of Energy in Kenya has started a

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campaign to educate people on efficient fuel use. For instance, people are advised to soak maize and beans overnight before cooking and to cover cooking food with a proper lid. But people complain the soaking "adulterates" their food. Nevertheless, experts also agree that something ought to be done in the rural areas where the trees are cut down to burn charcoal.

Efforts are being made to plant trees and replace those that have been cut. Until appropriate actions to protect the forests are taken, a few problems will continue to vex law enforcers and energy conservators. One of the problems is that the people do not own the land they occupy and are not concerned about tree planting and soil conservation. This makes the establishment of conservation measures difficult.

Environmentalists say that this can be overcome by having an education campaign and the laws protecting the trees should be enforced. Experts say that trees, especially exotic varieties, do exist that grow quickly and make high-quality charcoal—as high, in fact, as that made from indigenous trees.

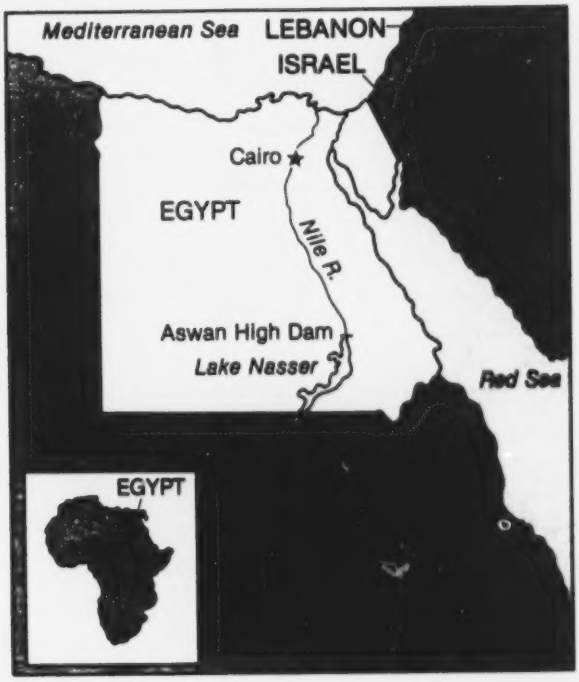
In such areas as Machakos, however, the acacia will continue to be the most suitable tree as it grows fast even in arid areas and has good propagation. To get this message across to young Mutisaya out there in Machakos will require dedication and patience.

Adapted from an article written for the "Global Edition" by Abel Ndumbu. This article appeared in Development Horizons, *Nairobi, Kenya, February 1989.*

Egypt: How to Look After the Nile

With a population of 55 million crammed into 4 per cent of its million-square-kilometre land mass, Egypt's quest for sustainable development has long been a primary objective. The country is bound by Israel in the north-east, Sudan to the south, Libya to the west and the Mediterranean in the north. The terrain is, for the most part, flat arid desert, with the exception of the Nile Valley, the delta and a few oases. Without the blessing of the Nile River, the country would be wholly—instead of 96 per cent—barren.

Egypt



Although most of Egypt's land area is made up of desert, the country is heavily dependent on its agriculture. About half the country's population is involved in the growing of food, cotton and other crops. But the harsh conditions of life in the agricultural sector have prompted many families to move to the cities, often to face equally dismal conditions.

In the past 30 years, land reforms have eased the enormous disparities of wealth among rural people and have helped increase production of crops. Larger farms have been able to benefit significantly in the current system. There remains an enormous rural peasantry without hope of improvement in its living standard.

Agriculture and the Nile

The main crops of the delta are cotton and rice, but there is also considerable production of fruit, vegetables, wheat, barley, maize, millet and sugar. Attempts to reclaim land have met with difficulty and, as a result, Egypt has failed to produce enough of its own food and is now importing heavily to meet the needs of a burgeoning population, increasing at an estimated rate of about 1.5 million a year.

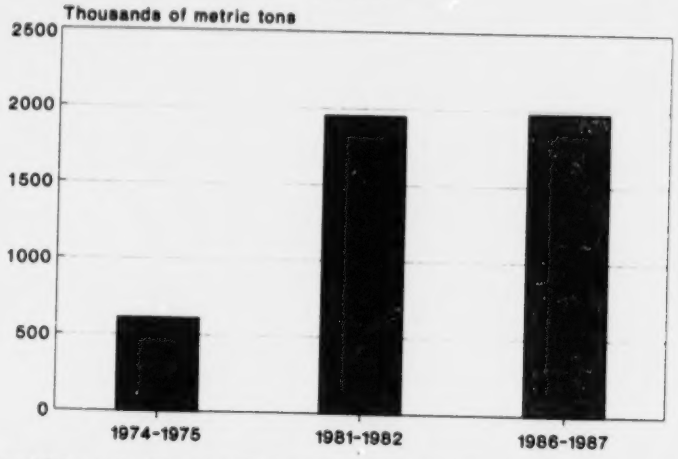
With most Egyptians entirely dependent on the Nile water, the point has now been reached where almost all Egypt's valuable water resource is fully utilized. However, the huge evaporation losses—which amount to 70 per cent of the total flow—is a dilemma the Egyptians are constantly battling to overcome. The Aswan High Dam project was intended to solve the water-shortage difficulty once and for all. The dam has eased Egypt's water

problem and boosted the number of crops that can be grown in a year without considerable cost.

Water Shortages

The Aswan Dam, completed in 1971, holds back the largest, artificial lake in the world, Lake Nasser. The dam makes possible the large-scale storage of water and planned use of all Nile water. There is no doubt that the dam has cushioned Egypt from the worst effects of the prevailing drought situation in the region. Even so, if the drought cycle in East Africa continues over further years, as seems likely, the country could face serious water shortages that would severely damage agriculture. This would be disastrous in a country already far from self-sufficiency in food. About half of the food requirement for Egypt's 55 million people is currently imported at an estimated cost in 1987/1988 of US$4 billion.

Figure 1
Food Aid in Cereal: Egypt



In addition to food imports, Egypt receives a considerable amount of food aid.

Water conservation measures are urgently required. Even if the Nile supply returns to normal over the next few years, the country's population explosion—there will be an estimated 69 million Egyptians by 2000—will bring a new crisis. Western irrigation experts report that long-term estimates of water supply show there will not be enough water for the population unless vast improvements are made in the way the country's water resources are managed. The water-shortage issue also directly affects plans for land reclamation, and experts now strongly disagree about the suitability of such schemes.

With a possible water shortage pending, few people are over-worried about the adverse effects of the Aswan Dam—as these continue to take their toll—even though, on balance, few would argue with the value of the dam. But, sooner or later the

problems will have to be faced. Problems such as:

- the scouring of the Nile bed below the dam;
- increased salinity in the lower water stretches;
- reduced sedimentation below the dam and heavy deposition within the basin, resulting in the need for increased use of artificial and costly fertilizers, which must be imported;
- the disappearance of fish—particularly sardines—off the Mediterranean coast; and
- possibly the most serious effect of all, a notable rise in the water table in some areas, due to hydrostatic pressures, and the year-round presence of water.

Other problems associated with irrigation include:

- the appearance of more permanent salinity and waterlogging conditions;
- the spread of bilharzia and other parasitic diseases; and
- the increasing appearances of the plant water hyacinth, which, if uncleared, can choke irrigation systems.

"Land degradation is a key problem, most often caused by excessive pressure on fragile ecosystems, taking too much from the land and putting back too little. But people often have too little choice. As populations grow, [thereby] increasing demand for food and other essential crops, subsistence farmers in many countries are forced to overexploit their land just to survive."

Mostafa K. Tolba,
Executive Director
of the United Nations
Environment Programme

Population Concerns

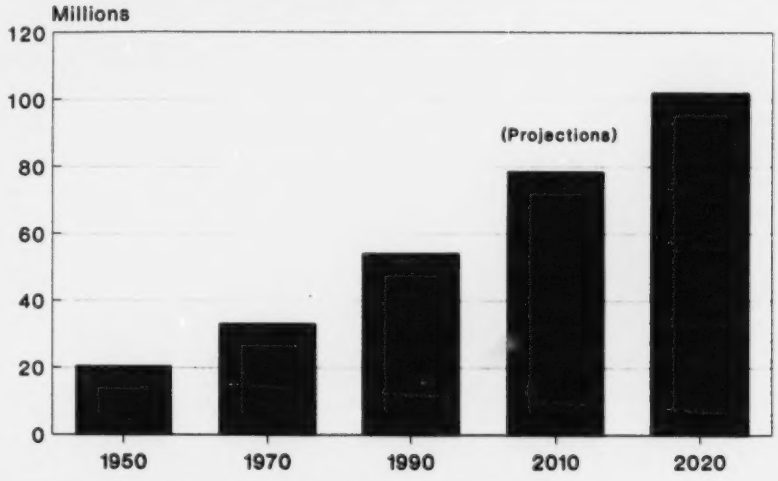
Population and maintenance of adequate food and water supplies are Egypt's most serious concerns. The country was one of the first in the developing world, and the first Arab country, to voice concern about and become actively involved in population issues. For more than 25 years the government and people of Egypt have gradually expanded activities in the areas of population policy and attempts to reduce fertility. Today, a host of governmental and nongovernmental bodies are involved in these activities. Throughout the 1980s, Egypt's President Husni Mubarak has stated his belief that population growth was inhibiting development efforts. However, the practical results achieved have not, so far, been encouraging.

From 1973 to 1975, Egypt maintained that the answer to its population problems lay in development, and that complex matters could not be addressed merely through the delivery of family planning and related services. The large extended family is a strong Middle Eastern tradition, since more children represent a willing workforce and insurance against destitution in old age. The government drafted a plan as the core of its development approach to population policy. The plan called for widespread family planning services and better communications programmes. The other points involved are improving and extending edu-

cational facilities; better employment opportunities for women; increasing agricultural mechanization; promoting industrialization; improving social security; reducing infant mortality; and socio-economic improvement for the family.

But in 1982, with a 2.6 per cent growth rate and a population of almost 45 million, it was clear that the government had not succeeded in achieving its targets of 1 per cent and 41 million respectively. In 1985 the National Population Council was formed and there is optimism that it will be able to achieve some success where others have failed. Egypt is currently striving to improve its economic status and a decrease in the population growth rate would do much to improve the government's credibility in the international market.

Figure 2
Population of Egypt: 1950-2020



Source: United Nations and Population Reference Bureau

The Scientific Approach to Agriculture

In a country which is heavily reliant on imported foodstuffs, methods of improving local agricultural production are constantly being researched. With the help of international agencies, Egypt has recorded some encouraging results. Training is recognized as an essential component of any competent programme. One project, involving research, experimentation and training is currently underway in Dokki, a suburb of Cairo (see box on next page).

Dr. Haddid, the project director, explained that agriculture in Egypt has changed enormously over the past two decades. "The soil of the Nile region is rich and extremely fertile and, thanks to the Aswan High Dam, we are able to cultivate two and sometimes three crops a year, where previously we could irrigate only one. This means that where the average tomato production was once about seven tons per feddan per year, it is now 14 tons or more. There are currently 6 million feddans under agricultural

Feddan
An Egyptian unit of area equal to 1.038 acres.
6 million feddans = 9,731 square miles, or about the size of Vermont

cultivation in Egypt but we are constantly battling to maintain this amount. About 1 million feddans a year are being reclaimed under the land reclamation schemes, but at the same time we are losing about the same amount to development and desertification.

"Since the opening of the High Dam some soils have declined; the increasing water table level affects soil properties, so agro-management is a must. Soil preservation is one priority in Egypt. Another is the rationalization of water use."

Adapted from an article written by Pat Lancaster for "Global Edition." The article first appeared in The Middle East, *London, England, January 1989.*

The Dokki Greenhouse Project

The Dokki project involves the cultivation of fruits and vegetables in greenhouses. Computers are used to monitor temperature, moisture levels, soil nutrient levels and other relevant information, which is relayed to on-site laboratories. This enables agronomists, students and technicians to create and control ideal growing environments.

"At Dokki we are adopting technology—experimenting and acquainting ourselves with it. Our research is applied practically at a number of satellite farms in the Delta region under normal conditions, frequently in simple plastic greenhouses without heating or ventilation. If there are any problems we can monitor them. The process enables us to advise the rural farmer with the benefit of first-hand experience. We know the average Egyptian farmer will never be in a position to grow vegetables with the help of an on-site computer but we are living in the technological age. If rural farmers can benefit by our research into nutrients, fertilizers, soil properties, meteorological studies—and they do—ultimately it will be to the advantage of us all."

The Dokki project involves controlled cultivation in some 49 greenhouses, most of which are constructed of plastic on a metal frame. Using mainly hybrid seeds from Holland, they are producing astonishingly high crop yields. They are also trying to produce strains of seed locally that are more suitable for cultivation in Egypt's harsh climate. Last year a tomato showing surprising resilience to water salinity was produced. Further work of this kind could produce new strains of other produce.

"We have three main project aims," Dr. Abu Haddid noted. "To continue to conduct research on soil and water rationalization, the findings of which will ultimately benefit many thousands of farmers, not only in Egypt, but throughout the Third World. Secondly, to pursue a training programme which takes account of our present needs but also those of the future and the new, educated farmer. With the knowledge from our local experiments and the international data available, we can train our farmers to be agricultural experts. We currently train about 200 students a year in Dokki. Our courses cover soil nutrition, irrigation, plant production and economics. In addition to theoretical farming, students gain practical experience on a day-to-day basis in the greenhouses. They are planting, watering, fertilizing and monitoring crops from the first planting and harvesting.

"To extend the number and range of schemes such as the one in Dokki is the final aim. These projects are designed for the new generation of farmers who are keen to break out of the traditional mould. Many of them are the sons and daughters of rural farmers. They see the benefits of employing the scientific approach. If we can help them achieve their aims then we will have achieved ours."

Asia: The Land and Its People

For miles and miles, all the marchers could see were stark brown hills.

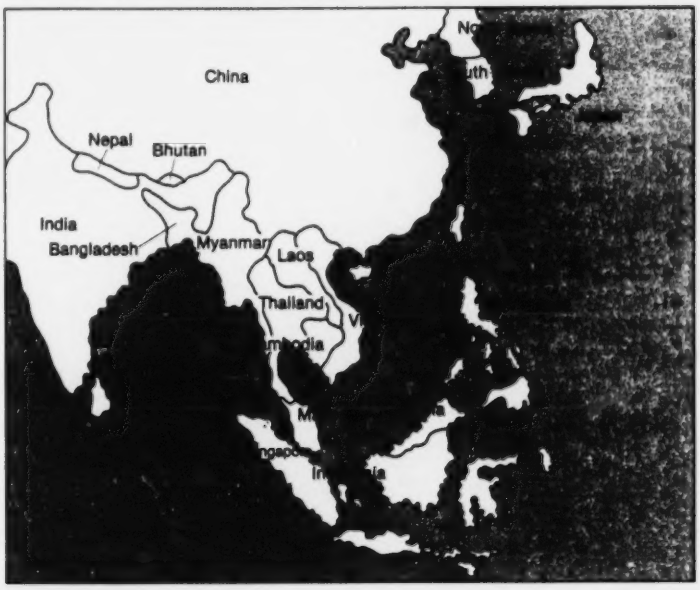
"There was not a tree in sight. Houses, yes. But not even a tree," recalls anthropologist Kailash Malhotra, who organized the march. "And I kept thinking, 'My God, what have we done?' "

For three months, several thousand marchers, aged six to 70, marched to bring attention to the ecology of India's Western Ghats. "An ecological treasure house had been systematically destroyed," says march coordinator A. Mohan Kumar. "And the ruin brought upon the people who depended on it for their sustenance."

He says "scenes of mindless devastation" were evident throughout the march, which covered the Western Ghats, a chain of hills stretching 3,500 kilometres across six states—Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra and Gujarat.

For centuries, the Western Ghats have functioned as the principal pillar of India's peninsular ecosystem Most of the major rivers that flow into the Bay of Bengal originate from the Western Ghats.

South and Southeast Asia



Between 1940 and 1980, nearly 5,000 square kilometres of forest were diverted for agriculture, irrigation and nonforestry purposes. The number of forest-based industries rose dramatically. Officials say around 20 per cent of the forest cover remains but others say it is less than 10 per cent.

Together with the Himalayas, the peninsular plateau bounded by the Eastern and Western Ghats has profoundly affected the climate, geology and the formation of vegetation types in India.

While it is hard to attribute forest destruction to changing weather patterns, the fact is that forests do affect the climate. Natural vegetation helps the transformation of enormous seasonal rainfall in the upper catchment areas like the Ganges River basins of the Himalayas into perennial streams feeding India's major rivers.

"There seems to be a relationship between vegetation and

Kilometre
1 kilometre = 0.6214 miles
3,500 kilometres is the distance from New York City to Salt Lake City.

1 square kilometre = 0.386 square miles
5,000 sq. kilometres = 1,930 square miles, or about the size of Delaware

In Nepal and other South Asian countries, forests are cleared primarily for agriculture and to provide wood for fuel.

rainfall, but its exact nature is yet to be determined," writes Dr. Jayanta Bandyopadhyay of the Third World Science Movement. He cites a study of vegetation and rainfall patterns in 29 stations in India over 100 years. The study shows that, as a rule, the larger the area of deforestation, the more indicators showing diminishing tendency of rainfall and rainy days.

A Critical Point

The monsoon rains did not fail India in 1988. But they were not enough for a dry and thirsty land.

The Indian drought in 1987 was the worst the country had seen in this century. And it has had an impact on the overall loss of momentum in world grain output.

The monsoon failure in India in 1987, drought in North America and China in 1988 and larger areas of fallow land in the Unted States in both years, "have depressed world grain harvest by nearly 10 per cent in two years," the Worldwatch Institute reports. India's crop is expected to recover, but "world grain demand, driven by the addition of 86 million people per year, continues to rise," says the Worldwatch Institute. "Such a dramatic decline in the world harvest of grain has no precedent."

China is a close second to the United States as a food producer. But severe drought in 18 Chinese provinces, including the grain belt in the Yangtze River area, could reduce its harvest by one-tenth. About 11 million hectares of Chinese farmland were adversely affected by drought.

Hectare
1 hectare = 2.47 acres
11 million hectares = 42,453 square miles, or about half the size of Ohio

Serious famine occurred in Vietnam when drought affected about 55,000 hectares of riceland. Rain was scarce in the Philippines while Japan, Indonesia and Thailand experienced severe drought in 1987.

By contrast, the rain flooded northern India, and floods brought disaster in Bangladesh in 50 of its 64 districts. Southern Taiwan had drought, then floods. Heavy rains hit Thailand. Floods in China caused US$435 million in damages.

It seems to be nature's way of saying that something is terribly wrong.

What seems obvious is that the earth's capacity to support life systems is limited. Rapid population growth is making more

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demands on the environment.

Feeding a rapidly growing population means clearing forests for permanent agriculture, which causes almost half of overall deforestation today. In tropical Asia, shifting cultivation is the main factor in deforestation. In addition, South Asians depend heavily on wood for fuel.

Some 1.8 million hectares of closed forest area are cleared each year in Asia. At this rate, by the year 2000, some 36 million hectares in Asia will have been converted to nonforestry uses.

As a consequence of deforestation, soils are impoverished and lose their water-holding capacity. The succession of floods and droughts increases the carbon cycle of the biosphere, leading to the "greenhouse effect." The gene pool for further plant and animal evolution is reduced. Wildlife habitat is endangered. And people are eventually affected.

Carrying Capacity

In 1990, the Asia and Pacific region accounted for 59 per cent of the world's population. It had 70.5 per cent of the world's agricultural population. The region has 23 per cent of the world's total land area and 31 per cent of the world's arable and permanently cropped land.

From 1961 to 1990, the average annual growth rate of the region's total population was 2.04 per cent. At the same time, the average annual growth rate in arable and permanently cropped land was only less than 0.5 per cent. The amount of land being made available for agriculture is not increasing as fast as the population. Population pressure is being exerted on a land area that is virtually static.

There are few countries where land is still available, at least in theory, for arable and permanent crop use. In 1985, only 15 countries in the region had such areas available: Bhutan, China, North Korea, Indonesia, Laos, Mongolia, Nepal, Papua

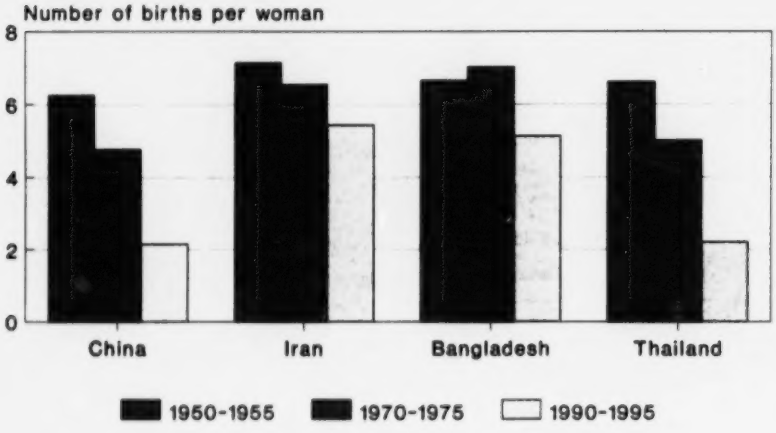
Ecological Instability in the Himalayas

Himalayan watersheds have become destabilized in the last century on a huge scale. Population pressure has caused farmlands to be over-cultivated and forests heavily stripped of trees. As a result, the River Ganges drains 1.46 billion metric tons of sediment into the Bay of Bengal every year.

Population growth in the Himalayas has run for decades at between 2 and 3 per cent per year. Rural population can be so packed in a limited area that as many as 15 people live on each hectare. The forest cover has declined by 40 per cent. Ecological instability has arrived in the once-pristine Himalayan slopes.

In some parts of Pakistan, for example, people must strip bark off trees that line the streets to meet their firewood needs. In other parts of the Indian subcontinent, in the Himalayan foothills of Nepal, for example, journeying out to gather firewood and fodder is now an entire day's work when before it required only a few hours.

Figure 1
Number of Births per Woman: Selected Asian Countries 1950-1995



Source: United Nations

New Guinea, Philippines, Solomon Islands, Sri Lanka, Tonga, Vanuatu, Japan and New Zealand. All other countries appear to have exhausted their land resources.

Land Degradation

One of the most disturbing findings of a United Nations Food and Agricultural Organization's (FAO) study concerned the consequences of unchecked land degradation. South and Southeast Asia would account for the loss of 36 per cent of potential crop land and a loss of soil fertility for much of the remainder.

This very real danger is already happening. In countries with already ecologically sensitive areas, rapid population growth has forced shifting cultivators to cut back on the fallow periods essential to restoring soil fertility, without applying fertilizer to compensate for the over-use.

The population pressure in permanent farming areas has resulted in the cultivation of more marginal areas such as land with excessive slopes, semi-arid areas and areas with unreliable rainfall. Their combined effects include over-cutting of trees and silting up of water channels, irrigation systems and dams. In semi-arid areas, the removal of tree cover has contributed to desertification.

The Vietnam News Agency reports "more forests are destroyed each year than what the U.S. destroyed with defoliants and herbicides throughout the Vietnam War." Wood demand per Vietnamese is estimated at 0.7 cubic metres per year, aggravating government efforts to stay ahead of deforestation. "When they cut the trees I tell them they are only cutting their own legs," says Professor Nguyen Vo Quy, Vietnam's leading environmentalist. "There is a strong movement for people to plant trees and 300,000 hectares per year are being replanted. There are more than the 200,000 hectares that are being destroyed yearly."

But international experts say government statistics are sometimes misleading, adding that Vietnam is headed in the direction of some African countries whose environment has been completely devastated by misuse. Beset with rapid population growth, Vietnam now has less than half of a hectare of land per person and only a small percentage of that is considered fertile.

Erosion now threatens 40 per cent of all land area. Two centimetres of topsoil from some slopes are being washed into rivers and streams every year. Intense monsoons and typhoons cause greater erosion in Vietnam than they do in neighbouring Thailand.

Sustaining Populations

Population growth rates are now slowing in some countries in Asia. Indeed, countries like China, Indonesia, Thailand, South Korea and Sri Lanka have shown that rapid population growth can be slowed. Since the 1950s, the average number of children per woman has actually declined in many Asian countries (see Figure 1).

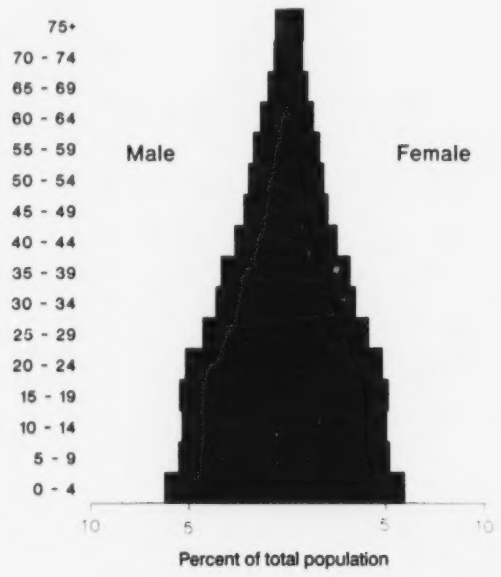
Still, Asia has the largest proportion of the world's population. The challenge is how to balance its population and resources.

A sustained increase in the birth rate and a decrease in infant and child mortality in the past 30 to 40 years have produced a young age structure in Asia's population (see Figure 2). The large proportion of the population aged 14 years and younger (34 per cent in 1990) depends on the working population for food, clothing, housing, transportation, education and employment.

At the same time, the number of women of childbearing age increased from 390 million in 1960 to 790 million in 1990 and is expected to reach 943 million by the year 2000. Thus, the potential for rapid population growth and a large proportion of dependents in the region is great.

Of the world's peoples who still do not eat enough to lead fully productive lives, two-thirds are found in South Asia. It is also there, principally on the Indian sub-continent, where the largest landless and impoverished populations are concentrated.

Figure 2
Age Distribution: Asia 1990



Source: World Bank

Close to 40 per cent of all rural households in South Asia, or 30 million people, own no land.

Fuelwood Dependence Scarcity

Landlessness and sheer poverty—among many other reasons—drive people into forests. Upland watersheds are often degraded as new and inexperienced migrants encroach upon forests. Even as the forests can no longer sustain the added "demand," the migrant farmers cut down trees and strip off natural vegetation in order to farm, not knowing that forests are important in the local ecology.

In South Asia, people depend on fuelwood for over two-thirds of their total energy consumption. The supply situation is acute in most countries, so acute that fuelwood must now compete for the meager incomes of the rural landless poor, when before wood was gathered for free. In India, guards are posted around forests to watch for fuelwood poachers. Acute firewood scarcity has even undermined administrative control in China where trees on plantations are sometimes uprooted for fuel as soon as they are planted.

The rural energy crisis occurred not because of development but because of the effects of population growth and the resulting increased use of fuelwood, increased animal grazing and farming on marginal lands. Urban growth further taxed the resources of the countryside.

The fifth of world-wide energy use that goes to the rural poor is very little in terms of total world energy. But as much as 95 per cent of energy consumption in rural tropical areas comes from wood or wood products. For rural residents, as well as the urban poor, wood is the dominant domestic fuel.

During the 1970s, prices of fuelwood doubled or even quadrupled. Today wood is becoming scarcer and more expensive. In some countries prices have climbed as fast as the price of kerosene. It has been said that in some deforested areas, "What goes under the pot now costs more than what goes into the pot."

Food

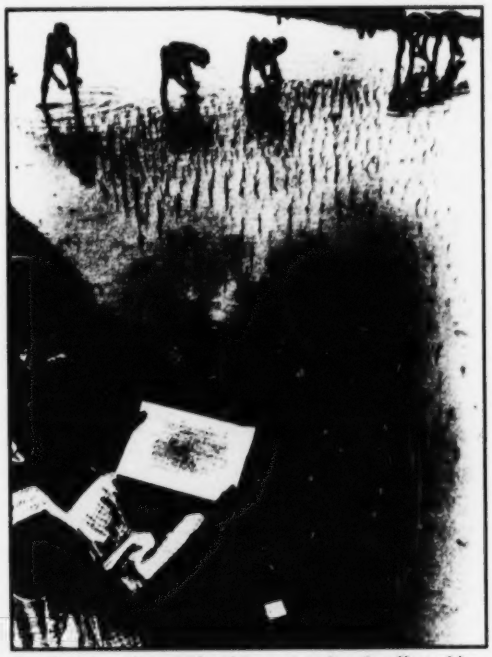
Population growth rates have dropped in Asia: 1.9 per cent in 1990 from over 2.5 per cent in the 1970s. But the momentum of earlier growth continues to tell on the increasing number of

people. By the year 2010, India's population could increase up to 1.23 billion, China could increase to 1.38 billion and Indonesia to 232 million.

The FAO reports that there are already over 300 million malnourished or ill-fed people in the region. To maintain present consumption levels, farmers must increase average grain yields by 26 per cent.

Drought and scarce rains in 1987 forced Asian countries in 1988 to use food reserves to compensate for poor harvests. Food prices have increased. And governments are taking a second look at the capacity of their farms to feed increasing populations.

Bad weather damaged rice crops in Bangladesh and Myanmar (formerly Burma). Drought seared large areas of Thailand, Laos, Pakistan and Sri Lanka. Typhoons and pests, respectively, damaged Philippine and Vietnamese paddy fields. The worst monsoon in a century hit India. Rice paddy production fell by 16 million tons in 1987.



South Asian rice production was seriously affected by drought and floods in 1987.

Even without bad weather, it may already be difficult to stretch the productivity of rice farms simply because, as with cereal harvests, the limits of production may already have been reached. Fifteen years have passed since Japan's rice yields first reached four tons per hectare. It has not reached the 4.5-ton mark yet. The same is true for South Korea.

China has difficulty boosting grain production because it is densely populated and has a small area of cropland per person. Rapid industrial development and the non-farm sector are pulling both labour and land away from farming. In the water-scarce north, water is diverted from farm to non-farm use. Further production is constrained by erosion, as in the Yellow (Huang He) River, which deposits 1.2 billion tons of topsoil into the ocean every year.

Land devoted to crops is shrinking as it is in most regions of the world. Since 1976, houses and factories have been built on Chinese cropland, which has shrunk by 13 per cent. More farmers in China favour cash crops over grains. Monsoon rains and forest destruction are taking their toll on India's soil. Grasslands are being exhausted by 360 million cattle, sheep and goats. It is estimated that 39 per cent of India's land is now degraded.

What is worrisome is that the slow-down in grain yields

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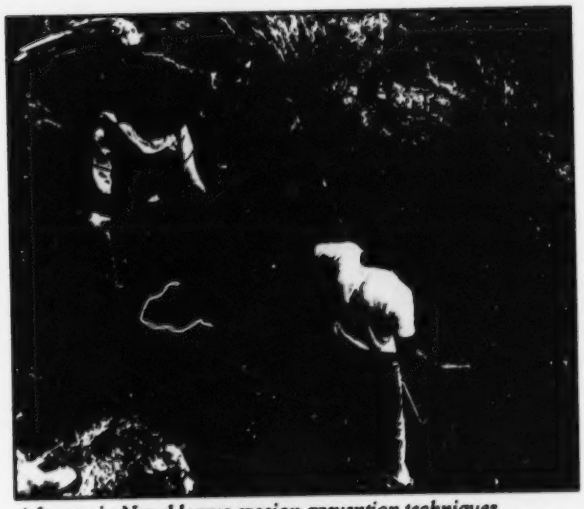

A farmer in Nepal learns erosion-prevention techniques.

occurs in some of the world's most populous countries, including India and China. Between 1965 and 1983, India more than tripled its wheat harvest when high-yielding crops were introduced. Since then grain harvests have not increased at all. China's grain harvests increased by nearly half between 1976 and 1984. But output has actually fallen since. In June 1988, officials announced that China would not achieve plans to surpass 1984 harvests.

Uphill Farming

An increasing population has forced people to modify traditional practices of agriculture. Shifting cultivation that follows logging is one of the major causes of deforestation in Asia. It is also one of the reasons why the region's population carrying capacity is on the edge.

Almost all people engaged in destructive shifting cultivation are landless tenants, farm labourers or land speculators. In Nepal the population pressure in the hills has caused people to migrate to the Terai areas and encroach into forest lands. In Thailand, unrest in neighbouring countries resulted in an influx of refugees into the country, which, together with encroachment by local Thais, contributed to deforestation.

Organized forms of resettlement, generally government sponsored, are more common in Indonesia, Malaysia, Sri Lanka and Nepal. In Indonesia under the transmigration programme (shifting of people from overpopulated Java, Bali and Madura areas to Sumatra and Kalimantan), the target is 25,000 families per year. In Sri Lanka, under the Mahawelli irrigation project, some 260,000 hectares of forest area will be converted to agriculture for organized settlements.

The loss of forest land for construction of irrigation and hydroelectric projects is observed in almost every country in the region, specifically in India and Sri Lanka. Work on India's Bodghat Dam is in progress in Madhya Pradesh. Five thousand people from 40 villages will be uprooted and virgin teak and sal forest will be lost. Resettlement threatens some 3,000 square kilometres of forest.

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Sustainable Conservation

Conservation, the sustainable development of natural resources and the demands of growing populations are not incompatible. There are many examples of successful sustainable practices that meet the needs of the cultivators. Northeast Thailand is one example. Villages surrounded by protected forests are asked to increase yields from their own land. They are encouraged to grow their own firewood rather than gather fuelwood from the protected area. Drinking water, primary health care and family planning services are made locally available.

In Sri Lanka, reforestation uses an age-old method called *taungya*, or community reforestation. The government allows landless slash-and-burn cultivators to lease up to three acres of degraded forest land. A condition of the lease is that farmers grow their own subsistence crops. They must also replant the watershed. Each cultivator has legal title to a small piece of land for three years. The government pays as incentive US$50 for every acre planted with crops. Any tree that dies must be replaced.

When the three-year lease is up, the cultivator is given another piece of degraded forestland to start another three-year lease and repeat the process. The original three acres are allowed to develop into a forest where no farming or logging is permitted until mature trees have grown. The watershed must be re-established before limited cropping is allowed.

Between 1983 and 1985, some 575 acres were reforested in Sri Lanka the *taungya* way. Over 1 million seedlings were raised in government nurseries during 1986 alone. The forests were restored and poor farmers were given a chance to earn a modest but adequate livelihood.

Consequences of Hydroelectric Projects

Construction of hydroelectric facilities in Asia results in loss of natural resources and the displacement of thousands of residents.

India's 260 metre-high Tehri Dam will be the second largest dam in Asia. The US$1.4 billion dam is about a kilometre away from Tehri, the centre of Garhwal culture in Uttar Pradesh. When the dam is completed, the town and 72 satellite villages will be submerged under a lake 42 square kilometres large. About 9,000 families (70,000 people) will be displaced, and forests—along with their biological diversity—will be destroyed.

The Narmada Valley Project—also in India—involves the construction of 30 major, 135 medium and 3,000 minor dams over 36 years at a cost of US$25 billion. Three major dams are completed, another nearly so and work has started on a fifth. The Indian venture will see the loss of over 300,000 hectares of forest and the possible resettlement of over a million people.

Over in Sarawak, Malaysia, the proposed Bakun Hydro Power Project will displace over 5,000 people and flood almost 700 square kilometres of forests. With a surface area of 73,000 hectares (larger than the island of Singapore), it will be Southeast Asia's largest dam.

German consultants in the area say that the lake created will be so large it will cause changes in the local climate. At least 80 per cent of primary forests, according to Forest Department estimates, will be flooded. "The immediate effects in the impoundment areas would be the submersion of valuable timber and some rare plant species which will totally disappear," reports Evelyn Hong, of Malaysia's Masyarakat Institute.

The Great Green Wall of China

A Great Green Wall of trees and shrubs is stretching across northwest China in an effort to ward off sand. A tree belt runs parallel with the ancient Great Wall of China, and sometimes right on its top. The trees are all part of a gigantic Northern China Forest Shelter Belt Project that will extend 7,000 kilometres from west to east.

The project aims to prevent the advance of moving sand dunes, protect farmland and pastures against sandstorms and wind, ensure uninterrupted traffic along transport routes and reduce soil erosion on highlands. Trees and shrubs are also grown to supply farmers with firewood.

From 1978 to 1985, trees and shrubs were planted on 6.05 million hectares, nearly twice the size of Belgium. Some 897,000 hectares were in areas threatened by sandstorms. Between 1986 and 1987, 1.78 million hectares more of land were covered by the project.

When complete, the wall will run from a point in Xinjiang near the country's western border to Binxian county in Heijongjiang province, in northeast China. It will extend across an area 400 to 1,700 kilometres wide from north to south. Its immense structure will sprawl across an area accounting for 41 per cent of China's territory—4 million square kilometres of land.

"It is not a single belt or even a number of belts," says Liu Wenshi, vice-director of the bureau in the Ningxia Hui Autonomous Region responsible for the growing of the green wall. "It is a vast, intricate system composed of massive tree shelter belts, smaller belts criss-crossing farmland and also large tracts of forests, shrubs and grass."

In China, a belt of trees has been planted parallel to the Great Wall in an effort to ward off land degradation. In all, 8 million hectares of farmland and 1.17 million hectares of grassland have been protected. The Chinese goal is to have 20 per cent of their country's territory planted to trees by the year 2000, up from about 12 per cent today.

India has reached one-third of its goal to have over 5 million hectares of degraded land turned each year into fuelwood and fodder plantations. It is putting more emphasis on grassroots reforestation. Japan now has the world's fourth largest area of tree plantations—nearly 24 million acres. In less than a decade, South Korea planted pine trees in an area equivalent in size to two-thirds of its area cultivated in rice.

"International development agencies now recognize that rural people form the only labour force large enough to plant trees on the vast scale that is needed," says the Worldwatch Institute. "More than ever before this labour force is being mobilized into action."

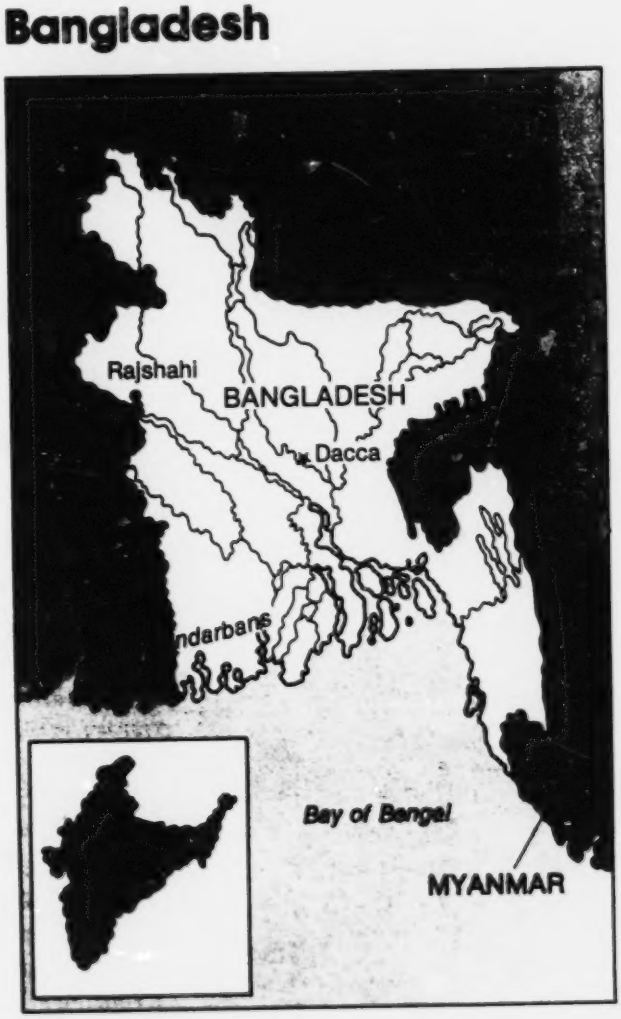
Adapted from an article written by Paul Icamina for the "Global Edition." This article first appeared in DEPTH News, *Press Foundation of Asia, Manila, Philippines, December 1988.*

Balancing Population and the Environment
The Challenge for Bangladesh

At the age of 46, Farmer Amin Ali came to the city seeking work. He had planned to bring his wife and four of his six children to the city as soon as his financial situation improved.

Mariam, Amin Ali's wife, kept waiting for her husband's call. She was forced to work as a domestic servant in various households in the village to support her family. For four long years the call did not come. Her situation worsened, and finally she also migrated to the city. But she could not find her husband. With no means of support she and her children settled in the city's ever-growing slums.

Mariam's own survival is her top priority. She no longer searches for Amin Ali. The cries of her malnourished baby sometimes grab the attention of a kind-hearted person at Dhaka city's busy commercial district, and a coin or two are thrown at the child. This child may have been Child 5-billion.



2,000 New Arrivals Every Day

Dhaka is the capital of and the largest metropolitan area in Bangladesh. In late 1988, the mayor of Dhaka announced that 2,000 people migrate to Dhaka every day to look for jobs and a better way of life. The city covers 100 square miles, and its population has already surpassed 7.5 million. Within the next decade the city will be facing a population of over 10 million people.

Four hundred years ago the township of Dhaka was created by the Mughal emperors. Up until 40 years ago Dhaka was a nice, clean, modest-sized town with plenty of greenery, river fronts, lakes, canals and ponds. Boating on the Motijheel ("pearl lake") was a favorite pastime for the Mughal and English rulers.

Today the Motijheel area, the site of the busiest commercial district in Dhaka, is a concrete jungle. Many of the bodies of water within the city have been filled in to make roads and buildings. The shade trees that used to line the streets, providing a respite from the blazing sun for weary travelers and

Population density in Bangladesh is 2,064 people per square mile, compared to 70 in the United States and 607 in the United Kingdom.

laborers, can now be seen only in old photographs.

The trucks, buses, cars and motorized rickshaws ply through the city, emitting toxic exhaust fumes. The city is polluted with dark, sooty, toxic air that causes headaches, respiratory problems and lung diseases. Dhaka is an example of how man can indiscriminately destroy his environment in order to meet his immediate needs.

Perhaps there is no other example of a city in the developing world that has changed its character by growing and expanding so rapidly and in such an unplanned and uncontrolled manner. New roads and thousands of houses, apartments and shops are being built, and yet they are still inadequate for the needs of a rapidly growing urban population.

If housing, schools, shops, water supply, sewer system, hospitals, transportation and recreational facilities are considered part of the basic amenities of city life, then 90 percent of the population of Dhaka is deprived. What is plentiful is malnutrition, disease, poverty and above all, frustration. Medical clinics run by the Save the Children Fund treat over 50,000 malnourished, dying children each year.

The capital city's main concern is the pressure of the increasing population. Bangladesh is now the most densely populated country in the world. There are over 2,000 persons per square mile. As the population increases, pressure mounts on available resources and the environment. Unlike earlier in the country's history, there is no chance of expanding the existing political boundaries or of having people move to other countries. Thus over 114 million people are being squeezed into an area of 55,600 square miles. Villages that used to offer an easy subsistence economy can no longer do so. The number of landless people is increasing rapidly; over 60 percent of the village population is landless. About 80 percent are living below subsistence level.

Modern technology is replacing the traditional occupations. There is the general belief that automation will bring economic prosperity and eliminate poverty. So more automated industries are being set up instead of labor-intensive industries. Some people

say that this part of Asia has stepped into the 21st century without experiencing the 20th century first.

A History of the Country's Decline

Bangladesh was a major producer of food and textiles in this region for hundreds of years. The famous "Dhaka Muslin Cloth," other products and technology used to be exported throughout the world, particularly within the southeast Asian region. As the population grew, people migrated to start new settlements in nearby lands. Settlements grew in Thailand, Kampuchea, Indonesia, Malaysia and other countries, developing a culture based on an agricultural economy.

British colonial occupation hindered interaction. The exchange of trade, skills and technology stopped and development stagnated. Countries in this region regained their freedom at the end of World War II, after 200 to 400 years of colonial occupation. It was as if "Rip Van Winkle" had awakened from a sleep lasting hundreds of years. The mainstay of these countries was the agricultural industry, still toiling with the 2,500-year-old plough and bullock system.

The villages in this region are the core of the agrarian economy. However, because the village economy can no longer provide a livelihood for the growing population, farmers like Amin Ali and his family rush to the cities like a tidal wave. In 1960, Bangladesh was only 5 percent urban. In 1990, 13 percent of the population lived in cities.

People who are desperate to find shelter and a meager source of food will settle in marginal areas not capable of supporting them. In Bangladesh at the Bay of Bengal, islands are formed naturally as sand and silt build up in the river and delta area. These islands are known as "chars." People settled by the thousands on one of these chars called the Urir before it was fully developed and before any plants had grown. A tidal wave in 1985 swept the island and killed thousands of settlers.

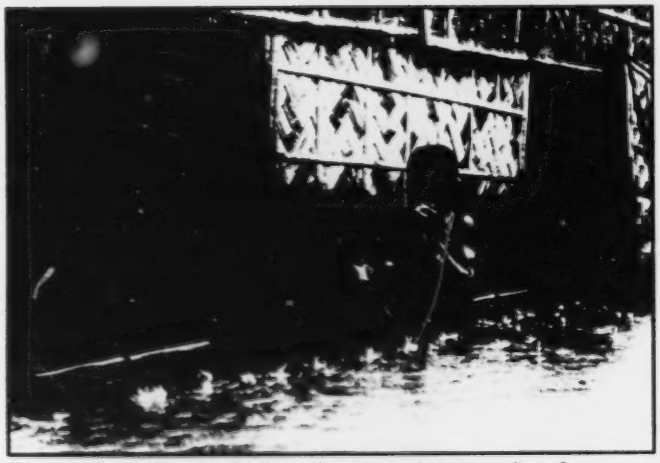
The population boom is not a crisis for Bangladesh only. It is a problem for the entire world. But, the problem here is different. With no increase in the land area and the capacity for production, the country must deal with malnutrition, natural disasters and periodic famine. In order to increase agricultural production, actions are taken that upset the environmental balance. The use of chemical fertilizers and pesticides has in-

creased manifold. More and more water is pumped out of the water table, and although rains return some of it, the overall water level is decreasing every year. Indiscriminate cutting of trees, not only for household fuel, but also for large scale commercial activities, is creating deforestation, a major catastrophe.

The water supply crisis in urban areas has not stopped the flow of people to the city. Likewise, poverty and hunger have not stopped the population explosion. The population growth rate for Bangladesh is 2.5 percent, with no proportional increase in food production. The population of Bangladesh will grow to 146 million by the year 2000. With the existing poverty level the population explosion will cause heavy pressure on the environment. The consequences of this are well understood for Bangladesh. But the rest of the world will also be affected. The human race should work together for the sake of human development. This crisis is a challenge to all mankind.

Man-Made Floods

Bangladesh faced the worst drought of 40 years in 1979, resulting in the loss of 2 million tons of crops. During the subsequent years drought and floods hampered the crop production. The president of Bangladesh called the flood of 1987 the worst in 70 years. It directly affected 20 million people—20 percent of the total population. But the flood of 1988 surpassed all the previous floods.



Frequent floods threaten the lives of an increasing proportion of Bangladesh's population.

The 1988 flood was reminiscent of the great flood of Noah's time. Eighty percent of the total land area of Bangladesh, including the city of Dhaka, was submerged. Experts believe that this flood, unlike the flood of 1987, was man made. The great Himalayan range that protects this region and gives it a unique individuality has now, under the pressure of a population explosion and environmental pollution, turned hostile. Deforestation in the Himalayas caused the melting snow on the mountains to turn into a gigantic flow that rushed down unabated, causing a flood. Bangladesh suffered nearly $1 billion worth of dam-

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age, 25 million people were made homeless and 3 million tons of crops were lost.

The origin of the flooding in Bangladesh is outside the country's geographic boundaries. The flood waters travel from Tibet through the Himalayas, the northern stretch of India, Bhutan and Nepal into the low lying Bangladesh. They pass through the rivers Radma, Brahmaputra and Meghna and fall into the Bay of Bengal. A reasonable amount of flooding increases the fertility of the soil, but an excessive amount causes devastation.

The Himalayas can no longer hold onto the flood waters because of deforestation in that region. In the last 50 years, Nepal alone has lost half of its forest reserves. The cleared forest areas are being used for cultivation. And as these forests are not being replaced, there is nothing to stop the flood waters from rushing down to the subcontinent. Immense quantities of topsoil, stone and pebbles flow with the water and silt up the river beds. This reduces the capability of rivers to carry large amounts of water, which also contributes to flooding in Bangladesh. In 1979 a program was undertaken to regularly dredge the rivers and dig canals to prevent flooding. However, the devastating flood of 1988 has proven positively that a permanent solution to flooding is an absolute necessity.

Forest industries provide most of Bhutan's foreign exchange earnings. However, deforestation in Bhutan contributes to the destruction of the Himalayan watershed.

Experts agree that the concerned countries—Bangladesh, India, Nepal, Bhutan and China—must agree to work together. Even with cooperation it will take at least 20 years to achieve permanent flood control. Bangladesh has taken the initiative to build up cooperation regarding the flood problem, but it is still in the initial stage. Despite the distrust among the nations in this region, there is a strong desire to cooperate.

The whole world has responded to solve the flood problem in Bangladesh. This is definitely a good sign. With the cooperation of the world community, the flood control program begun in Bangladesh should lead to a sustainable solution. Nature, weather and the environment are not confined within political boundaries. The sooner this is realized, the sooner society benefits.

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The Environment versus Development and Progress

Bangladesh is one of the poorest countries in the world, with an average per capita annual income of US$170. A concerted effort has been made during the last three decades to encourage development. However, Bangladesh has depended heavily on foreign resources and know-how for its development.

In addition, 70 percent of Bangladesh's budget is dependent on foreign aid. As a result, the country must contend with the interest and other conditional strings attached to foreign aid. Economists are apprehensive about the consequences to the future generations of inheriting a burden of foreign debt worth billions of dollars.

Development or progress achieved through foreign assistance is in conflict with the needs of the environment. The effects of industries on the environment have been ignored in Bangladesh and many other developing countries until recently. While Bangladeshi government planners are now giving consideration to this factor, the wishes of the donors and investors still are of paramount importance.

The World in 2000

What will be the condition of Bangladesh in the next century? While the developed countries continue to progress, 90 percent of the population of this country will be malnourished and illiterate. Bangladesh is steadily advancing toward a hostile environment without the tools to face it. The growing population of young people will cause tremendous problems for the country in the beginning of the next century. At present millions of children are roaming the streets, looking for ways to survive.

The main concern of everyone today should not only be the consideration of the problems of the present, but also the protection of the environment and sustainable future development for the children.

Earth's ecology and environment are at stake now. The greenhouse effect is a serious threat to the existence of island and deltaic countries like the Maldives, Indonesia and Bangladesh. The erratic climate and melting of the polar ice caps may result in a rise in the sea level. The Maldive president in 1985 expressed his concern over the possibility of the island going under water in a few decades. Bangladesh, with the largest delta in the world, faces a similar problem. Bangladesh will continue to face repeated

floods, cyclones, drought and other natural disasters and will face the double dilemma of reducing the high birth rate and child mortality. It seems almost impossible to escape the vicious circle of a population burden of 115 million in a small geographic area, with natural calamities, new environmental hazards and extreme poverty.

Amin Ali, his wife Mariam and their children are all staying in the same city unable to contact each other. They are all struggling to survive. They worry about what they will eat tomorrow and where they will sleep. They see no ray of hope. They cannot dream of any future. Is it possible to unite the family again? Can someone find steady work for them? Something must be done. Otherwise the result will be that summarized in the following comment from Mr. James P. Grant, Executive Director of UNICEF: "The persistence of absolute poverty on this planet is ultimately inseparable from the issues of violence, instability and environmental deterioration which affect us all and will affect us increasingly as we move towards the opening of the new millennium." (Preface, *The State of the World's Children*, 1989)

Adapted from an article written by Shahadat Chowdhurry for the "Global Edition." The original Bengali version was published in The Weekly Bichitra *of Dhaka, Bangladesh, February 1989.*

What will we face in the next century?

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Disappearing Deltas

People living in the world's deltas and coastal lowlands—from Bangladesh to the Nile, from Guyana to China, from Papua New Guinea to Louisiana—will be among the first to suffer from sea-level rise. The effects will be worse where, as in many areas, the land is sinking anyway, compounding the impact of the swelling oceans.

Bangladesh—perched on the fragile triangle of land where three of the world's greatest and fiercest rivers flow to the sea—probably faces the greatest crisis of all. Eighty per cent of the country is made up of the delta of the Ganges, Brahmaputra and Meghna rivers; half of it is less than five metres above sea level.

Kilometre
1 kilometre = 0.6124 miles

Already floods regularly inundate a third of the country. Deforestation in the Himalayas has made them more frequent and more severe. When the mountains were covered with trees, overwhelming floods only hit the country every 50 years or so. By the 1970s they were happening every four years. At the end of the 1980s they seemed to be still more frequent, with record floods in 1987 and 1988, the last covering 85 per cent of the land. And every year cyclonic storms hit the country, sending six-metre high surges racing up to 200 kilometres (km) inland.

About 110 million people live in Bangladesh, double the number in 1961, and the population is expected to reach 165 million by 2005. It is one of the most crowded countries on earth, and the pressure of rising numbers is increasingly forcing people to live on highly vulnerable land, like the chars of silt constantly rising in the delta.

An expert study prepared for last year's Commonwealth Prime Ministers' Conference estimated that a one-metre sea-level rise would permanently inundate 16 per cent of the country's land, destroy some 2 million houses and make one-tenth of its people homeless. Farmland currently producing an annual 2 million tonnes of rice, 400,000 tonnes of vegetables, 200,000 tonnes of sugar and 100,000 tonnes of beans—and accomodating 3.7 million cattle, sheep and goats—would disappear beneath the waves. More than 10,000 bridges, over 26,000 km of roads, and about 1,500 km of railways would be swept away.

Nor is this all. Some analysts suggest that the most serious effects of sea-level rise will be felt not in these coastal districts, but upstream. The rivers would rise with the sea, flood more easily and more seriously even than today, and undergo rapid and catastrophic changes. Salinity would penetrate inland, poisoning cropland and polluting the water supplies of cities like Chittagong.

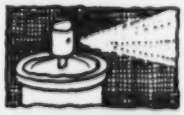
Studies at the Woods Hole Oceanographic Institute, which place more emphasis on the degree to which the land is already sinking (partly due to the

Figure 1

Greenhouse Gases

Five gases are responsible for the bulk of global warming. The faster population grows the hotter the world will get.

LOW LEVEL OZONE produced by car exhausts, accounts for 8% of global warming.



CHLOROFLUOROCARBONS account for 20% of warming. Used in refrigeration and air conditioning, aerosols, packaging.

NITROUS OXIDE emitted by humus decomposing rapidly after forest clearance and by the breakdown of nitrogen fertilizers.

METHANE accounts for perhaps 16% of the warming effect. Two-thirds of emissions are from human-made sources. Half of these come from decomposition in irrigated land and from the guts of livestock.

CARBON DIOXIDE is responsible for around half of global warming, caused by the burning of forests and fossil fuels.

Source: United Nations

effects of 120,000 wells drilled for drinking water), make even gloomier reading. They estimate that, at worst, 18 per cent of the country's land would be under water by 2050. By 2100 over a third of the land, home to 35 per cent of the people, could have disappeared.

The Nile Delta is sinking rapidly, because the Aswan High Dam traps the silt that would otherwise have been carried downstream to replenish it. Most of Egypt's people live there, at twice the population density of Bangladesh, crammed in by the desert that covers more than 96 per cent of the country. The Woods Hole team estimates that up to 19 per cent of the country's habitable land, containing 16 per cent of its rapidly increasing population, could be swamped by 2050. By 2100 one-quarter of the land and the same proportion of the nation's gross domestic product (GDP) could be destroyed, and a quarter of its people made homeless.

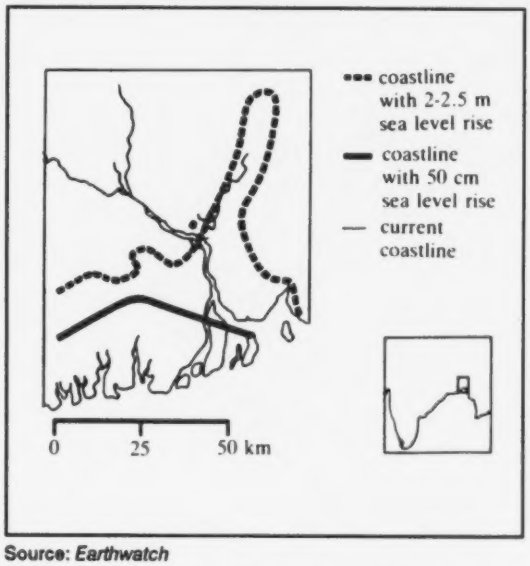
Ninty per cent of Guyana's 900,000 people live on only 3 per cent of its land, in a coastal plain that already lies beneath high-tide level. Sea walls were erected in the late 18th and early 19th centuries, but these are already severely eroding and will not contain sea-level rise. Just a half-metre rise in sea levels would inundate the area where most of the people live; a 1.5-metre rise would affect virtually the nation's entire cultivated area.

Bangkok is sinking by 13 cm a year due to the abstraction of groundwater. In Papua New Guinea, rising sea levels are expected to flood one quarter of the country's coastline. Venice is in danger from a 20 cm rise or more. Manhattan stands just four feet above sea level, and the Gulf of Mexico is expected to surge more than 50 km inland, swamping Louisiana's bayous and marshland.

Many buildings in Shanghai are already below the high-water mark, and Chinese experts reckon that a half-metre rise would flood the whole city of Canton. A one-metre rise, says Dr. Han Mukang of Beijing University, could inundate most of China's richest low-lying plains—the southern half of the Lower Liao river plain, the eastern halves of the Yangtze Delta and the North China Coastal Plain, and the whole of the Pearl River Delta. China's food production would be devastated, and 30 million people would lose their homes.

This article was written by John Rowley of the International Planned Parenthood Federation. "Disappearing Deltas" first appeared in Earthwatch, *Number 38, 1990, London, England.*

Coastline of Bangladesh



Source: *Earthwatch*

Map shows how far sea would invade Bangladesh with 50-cm and 2.0-2.5-cm rises. A 1-metre sea-level rise would result in the displacement of 10 per cent of the population, innundation of 2,000 square kilometres (14 per cent of the net cropped area), output loss equivalent to 13 per cent of GDP, 1.9 million homes, 1,470 km of railways, 10,300 bridges and over 20,000 km of roads.

People-Resource Balance A Must in the Philippines

The myth that the Philippines is still rich in natural resources is being shattered by researchers at the University of the Philippines. A closer look at resource depletion points to excessive population as the major cause of the failure of Filipinos to pursue sustainable development.

Rapid Population Growth

The Philippines has experienced rapid population growth for several decades. Figure 1 illustrates that the population tripled in size between 1950 and 1990. Although the *rate* of growth has declined from 3 percent in the 1950s to 2.6 percent today, the large proportion of young people and increasing numbers of women in their childbearing years ensure that the Philippine population will continue to grow rapidly for some time.

The growth of the "upland" population in the Philippines is of increasing concern. The upland areas are defined as lands with an 18 percent slope or higher. They are the home of the public forest lands and approximately 18 million people. Many of these upland dwellers live in forested areas and depend on the land and resources for their survival. The upland population is considered to be the most impoverished in the Philippines.

If current population growth rates continue, two major consequences are evident. First, forest lands will increasingly be converted for agricultural uses to meet basic food requirements. Continued migration to upland areas will lead to increased population density and a decline in the size of farms. Both factors often result in dwellers using more destructive farming methods such as the cultivation of marginal lands and the shortening of fallow periods leading to the adoption of more intensive farming.

These actions lead to the destruction of forest cover resulting in soil erosion and other environmental effects including flooding and sedimentation Soil erosion rates in the disturbed areas average over 30 tons per hectare per year, well in excess of the five to 10 tons per hectare per year for sustained production. The

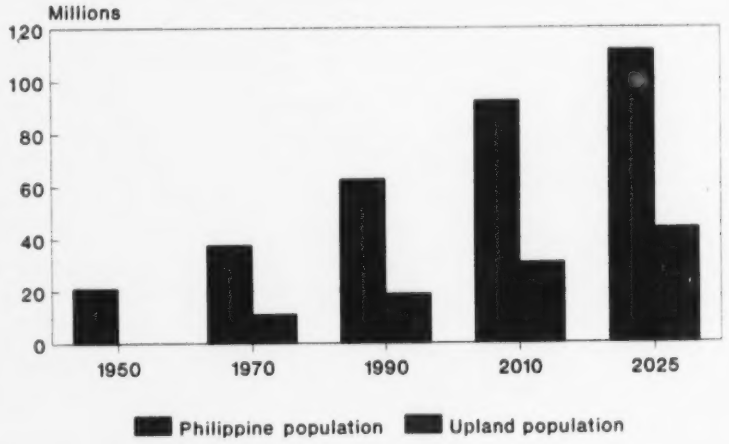
Philippines

Hectare
1 hectare = 2.47 acres

ultimate effect of this cycle is the reduction in crop capacity, which threatens the ability of the Philippines to feed its teeming population.

New migrants to the upland area may have an even greater detrimental effect on the environment as they are not accustomed to living in mountain environments. Some areas have been virtually transformed into degraded croplands and bush due to this lack of knowledge. The actions of these upland farmers and other groups have led to the loss of half of the total forest area between 1960 and 1985. Little hope is held for regeneration of the original forest because of the destructive slash-and-burn farming methods of the increasingly large communities of upland farmers.

Figure 1
Philippine and Upland Population: 1950-2025



Source: United Nations

Coastal area populations, dependent on fishing for their livelihood, also have remained poor. Population growth has absorbed increases in the fish catch. There has also been an absolute reduction in the catch in the last decade due to overfishing (including illegal fishing using dynamite and cyanide poisoning and illegal coral harvesting) and extensive deterioration of marine and terrestrial resources.

The serious environmental problems in the coastal areas that are associated with population pressure are: the physical and chemical damage to coral reefs; the destruction of the mangroves; the pollution of freshwater lakes, swamps and rivers; and the deterioration in the quality of marine, brackish and fresh water through increased sedimentation and industrial pollution.

The basic causes and effects of land and water resource degradation in the Philippines, according to researchers, are a high population growth rate, poverty, a skewed distribution of resources, an undervaluation of natural resources, ineffective government controls and greed. These are the problems that must be tackled in order to achieve sustainable development.

Population pressures contribute to environmental problems in both coastal and upland areas.

Achieving Sustainable Development

With diminishing resources and increasing population, the country is confronted with critical problems of sustainable development. President Corazon Aquino has emphasized in recent statements the need to establish a sustainable balance between population growth, resource use and the maintenance of environmental quality.

Efforts to slow population growth are often complicated by the religious beliefs in the country. A comparison between Thailand (Buddhist) and the Philippines (Catholic) points to the interesting fact that while both started with a 3 percent annual growth rate in the 1960s, today Thailand's is 1.5 percent while Filipinos still multiply at 2.6 percent a year. The Catholic hierarchy leaves family planning programmes to nongovernmental organizations.

Regulating population also counts in efforts to lift the economies of poor countries. The remarkable demographic transitions in the Newly Industrialized Countries (NICs) have been the result of rising household incomes and strong fertility reduction programmes (South Korea, Singapore, Taiwan). It is no coincidence that Thailand, with an effective population programme, is emerging today as Asia's fourth new industrial dragon.

On the other hand, China has achieved a low birth rate through strong government controls and incentives, despite the lack of marked economic development. Lower fertility rates have been achieved in Sri Lanka due to better education and health services, including family planning. This would indicate that a strong population program can lead to lower fertility rates even without waiting for sustained economic development. These countries offer the Philippines various models from which to select its own course of action.

It is obvious, judging from the various bills and resolutions pending in both houses of the Philippine Congress, that Filipino legislators want to strengthen the government's weak and indecisive population programme. One senate resolution seeks a more

effective programme. It stresses the need for rationalizing population growth in light of swiftly diminishing land availability, heightened environmental degradation and rising levels of unemployment that adversely affect the welfare of the poor. Rapid population growth makes it more difficult to alleviate poverty and improve the quality of life of Filipinos, which after all is the ultimate goal of family planning.

There is a strong push for an improved population programme in the Philippines. There is more determination on the part of the political leadership to pursue the goals of sustainable economic growth while addressing the problems of overpopulation with greater political will. Equally concerned with alleviating poverty, the Catholic Church presented its position paper on population and birth regulation, saying that rapid population growth may present an obstacle to development.

In essence, the extent of real progress in Philippine family planning will depend on how far the Catholic Church and the State, given their positions on population-related issues, can work together in their common pursuit of sustainable development as an effective means of easing poverty.

Based on a news report by Domingo Abadilla, which appeared in M.P. Chronicle, *Bhopal, India, January 1989.*

Latin America
Population Growth and the Environment

Latin America – and to a lesser degree the Caribbean – has gone through wrenching demographic and economic changes that now threaten the region's environment and quality of life. Most of these problems are self-evident – people in Kingston, Mexico City, Santiago, São Paulo and other cities do not have to be told that the air they breathe is foul.

We are all witnesses to the following "forceful reminders" that the environment and quality of life are degraded.

Hectare
1 hectare = 2.47 acres
5.6 million hectares is slightly less than the size of West Virginia.

- More than 5.6 million hectares of Latin American tropical forests are lost annually, over half of the world's yearly total. In the process, valuable plant species are being wiped off the face of the earth.
- Of the area's 280 million urban population in 1985, 54 million have only limited access to drinking water and 117 million have no sewage facilities. Of the 126 million rural residents, 102 million lack clean water and 113 million lack sewage services.

Latin America

Until recently, American civilizations lived in harmony with their environment. "But," according to Enrique Iglesias, the President of the Inter-American Development Bank, "in the last 30 or 40 years two major previously unknown phenomena burst upon the scene: dramatic population growth and technological revolution, which acknowledged man's unlimited ingenuity and capacity to provide for the social good, but also created growing threats in the environments where they were applied.... What is new is the qualitative dimension of the phenomena and the way in which these two elements, population and technology, can combine to

work against the environment."

From 1950 to the present, the population of Latin America and the Caribbean jumped from about 165 million to nearly 450 million. During the 1950s and 1960s, the region had the fastest population growth of any world region, even though some countries – Argentina, Cuba and Uruguay, for example – had only moderate population growth rates. About 90 percent of the region's population growth since 1960 has been in urban areas, and today the population of Latin America and the Caribbean is about 70 percent urban, the result of high birth rates and migration from rural areas to the cities.

Table 1

Foreign Debt and Interest Payments: Selected Latin American Countries

Country	Total external debt (in millions of dollars)	% of GNP		Total interest (in millions of dollars)	
	1988	1970	1988	1970	1988
Brazil	$114,592	12.2	29.6	$135	$10,117
Mexico	101,567	16.2	52.4	216	6,554
Venezuela	34,657	7.5	49.0	40	2,043
Costa Rica	4,530	25.3	89.2	7	160
Haiti	823	10.2	27.7	0	8
Argentina	58,936	23.8	58.6	121	2,560

Source: The World Bank

To some extent, rapid population growth represents the successful application of modern medicine. However, it has also brought many problems that are easier to list than to remedy. The rapid growth in the number of young people meant that economies were pressed to feed, educate and employ more dependents. During the 1960s and 1970s, when the region's larger countries averaged a 6 percent annual increase in gross national product (GNP), there was hope that economic expansion would accommodate population growth.

Some of the economic growth was at the expense of the resource base and the quality of life. Nontraditional exports like beef, and agricultural commodities like cotton, put pressure on the land without absorbing surplus rural labor. Much industrialization was accomplished by labor-saving devices. Thus, despite economic growth, many youths remained undereducated, underemployed or unemployed. The rapid economic expansion left an important "social debt."

In the wake of the world recession in the early part of the 1980s, foreign financial debt, which had helped fuel economic growth, came due (see Table 1). To service the debt, Latin America and the Caribbean have been under growing pressure to export at all costs and to reduce domestic expenditures for social services and environmental protection.

The environmental problems of Latin America and the Caribbean are also global problems. In developed countries economic growth and industrialization have alleviated rural poverty and provided a high standard of living, but the environment has paid a heavy price. Because of environmental damage, the escape from poverty through industrial development may no longer be an appropriate model for the developing nations of Latin America and the Caribbean.

The Brundtland World Commission on Environment and Development emphasized the need for a new era of economic growth and development based on policies that "sustain and expand the environmental resource base" of the earth. Establishing a sustainable relationship between population growth and environmental resources in Latin America and the Caribbean will require:

- providing urban alternatives to mega-cities;
- curbing tropical deforestation;
- ending the degradation of agricultural lands;
- improving management of major watersheds;
- overcoming water and air pollution;
- reducing the production of hazardous wastes; and
- slowing and eventually stabilizing population growth.

Urban Growth

Rapid urbanization is becoming one of Latin America's most pernicious problems. By the year 2000, three-quarters of all the people in Latin America and the Caribbean will be urban residents.

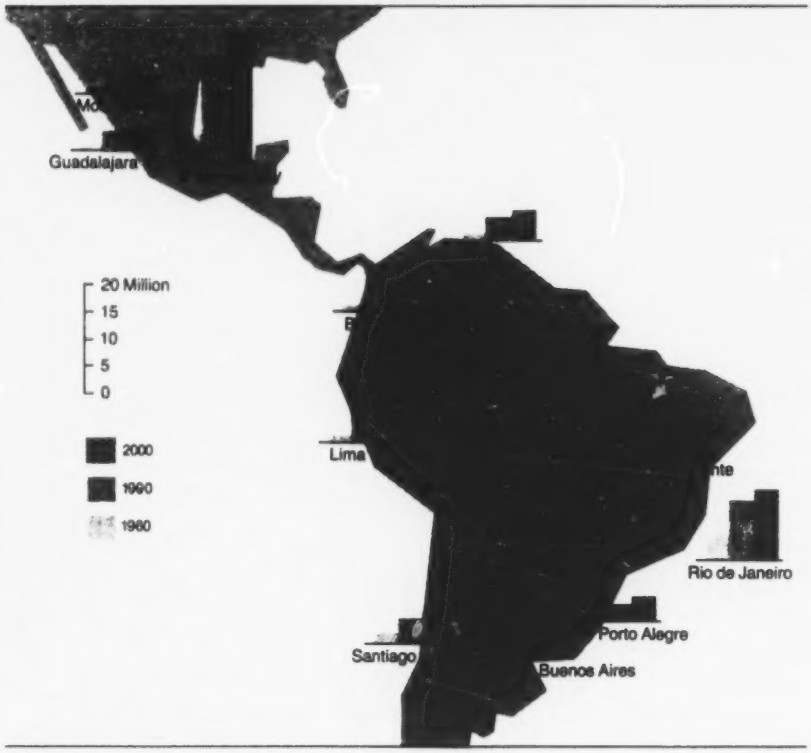
Because urbanization concentrates people, it puts a heavy demand on the supply of food, energy, water and shelter. A city of 1 million consumes in a day about 625,000 tons of water, 2,000 tons of food and 9,500 tons of fuel. It generates 500,000 tons of waste water, 2,000 tons of solid wastes, and 950 tons of air pollutants. Mega-cities—those with over 5 million inhabitants—also consume arable and forested land. When urban growth is rapid and persistent, the toll on the surrounding countryside can be devastating.

In over-crowded cities, many people are condemned to live in squalid shanty towns, squatter settlements and slums. In Rio de Janeiro, for example, at least 3 million people live in slums, perched on steep hillsides. The construction of temporary shel-

ters strips away the vegetation that anchors the soil and protects the watershed. In February 1988, mud slides claimed the lives of 277 residents of Rio de Janeiro and left 20,000 more homeless.

The urban problems generated by the growing numbers of poor migrants from Brazil's interior are yet to be addressed successfully, while opening up the Amazon to relieve population pressures on coastal cities has created another set of environmental problems.

Growth of Latin America's 12 Largest Cities: 1960-2000



Policy-makers throughout the region must turn their efforts to achieving a better balance in the physical distribution of the population. Regional development policies and the development of medium-sized cities relieve the pressure on large metropolitan areas. These approaches must be integrated to ensure that public services that reflect key health and population objectives can be delivered. They must take into consideration matters such as food production, water supply and sanitation and industrial policy (as it pertains to pollution), while assuring that the environmental resources upon which development depends are not damaged beyond repair.

Deforestation

The world's tropical forests are disappearing at an alarming rate. Forest areas equal in size to the continent of Australia are being eliminated each year, and another 10 million hectares are being degraded. The United Nations Food and Agriculture

Deforestation contributes to the global warming threat in several ways.

Organization predicts that 150 million hectares, or 12 percent of the remaining closed tropical forests, could be lost by the end of the century.

Deforestation in Latin America is largely the result of the development of cattle ranches, encroachment by villagers and landless subsistence farmers commercial logging and unplanned resettlement programmes. In Central America cattle ranching has destroyed some 20,000 square kilometres of forest each year since the late 1970s in order to provide cheap beef for the North American and European fast-food industries. Deforestation releases more carbon dioxide into the atmosphere and reduces the absorption of this greenhouse gas through photosynthesis, in this way adding to the global warming threat.

When the forests disappear, so will a wealth of flora and fauna. To save the planet's genetic diversity, countries have been setting aside protected areas, which by 1985 totalled an area the size of Western Europe. Conservationists maintain, however, that the size of protected areas needs to be tripled, if a truly representative sample of the earth's ecosystems is to be preserved.

Kilometre
1 square kilometre = 0.386 square miles
20,000 square kilometres is slightly larger than the state of New York.

Agricultural Degradation

Globally, improvements in agricultural productivity have been able to meet the challenge of rapid population growth. Between 1950 and 1980, world cereal production per person increased 9 percent per decade – however in the 1980s, it fell by 2 percent. Studies show that it could fall even further in the 1990s. Production has now fallen below consumption, leading to a 50 percent jump in world grain prices between 1986 and 1988.

Some 730 million people, almost all of them in the developing countries, do not eat enough to lead productive lives. About 20 million Latin Americans are considered chronically underfed. Throughout the developing world there are now large areas of land that can no longer grow enough food to feed the people who live there.

The loss of agricultural land is the result of poor land management practices, over-cropping and over-grazing, the misuse of marginal lands, excessive fuelwood harvesting, mining activities and urban and industrial development, all of which promote soil

erosion and degradation. For example, in Peru soil erosion approaches 15 tons per hectare per year across the entire country. Throughout the region, soil erosion and degradation are partly the result of population pressures on marginal land and overused land, but also are often the result of commercial, social and economic structures that favor urban populations over rural residents.

Watershed Management

Upland watersheds influence climate and rainfall, regulate the water flow in downstream areas and provide habitats for a variety of flora and fauna that are found nowhere else. But upland watersheds in tropical developing nations are being seriously degraded, at a rate of over 160 million hectares during the past three decades.

In the uplands of Ecuador and Peru, the natural instability of the soil is aggravated by high-intensity tropical storms. In some areas of Peru and Chile, entire mountain slopes have broken apart during heavy rains, creating mud avalanches. As agricultural production spreads from the valleys up the slopes, deforestation and slash-and-burn practices expose the land to erosion, at the rate of more than 1,500 tons per square kilometre per year.

Compared to this hemisphere, the Himalayan region in Asia faces far more serious watershed degradation. The River Ganges delivers 1.46 billion tons of sediment to the Bay of Bengal every year, versus 363 million tons delivered by the Amazon River to the Atlantic Ocean. But in the Andes watershed, deforested hills in Chile, Colombia, Ecuador and Peru show huge erosion scars. Unless better managed, Latin America's watersheds may soon become degraded on a scale approaching that of the Himalayas.

Air and Water Pollution

Fouled, disease-carrying water constitutes one of the major stumbling blocks to improving health in much of the developing world. According to the World Health Organization, some 1.2 billion people, or about one quarter of the world's total population, lack safe drinking water, and 1.4 billion have no plumbing and sewage systems. Water-borne diseases such as cholera, typhoid, diarrhoea, dystentery, malaria and intestinal worms claim the lives of about 5 million adults each year. These problems are

Air pollution is one of the biggest problems in Latin American cities. Automobiles and industry are the leading contributors.

most acute in the rural areas, but even in urban areas only about half of all people have access to sanitation facilities.

The lack of sewage treatment plants is a fundamental problem confronting Latin American and Caribbean governments. Where they exist, sewage lines typically deposit wastes directly into rivers and streams without pre-treatment. Panama Bay, for example, receives some 34 million tons of raw sewage each year from three river systems and 20 outfalls in Panama City and the Port of Balboa.

With its highly developed coastline, Ecuador suffers from acute deterioration of its coastal waters. The waters around Lima and Callao, in Peru, are also highly polluted from untreated waste disposal and runoff from mining and metal smelting. In the mountainous province of Tacna, near the Chilean border, two huge copper mines pump more than 73 million tons of debris and tailings that end up in the Pacific Ocean. Near-shore waters contain 21 parts-per-billion of copper, enough to poison a wide variety of marine life.

Air pollution in the region's biggest cities is a growing problem. In Mexico City, São Paulo and Caracas, the air is judged to be unfit to breathe because of pollution from vehicle traffic and industry. Every year, São Paulo pumps approximately 218,000 tons of sulfur dioxide into the air. Not surprisingly, the city is beginning to suffer from the localized effects of acid rain. Of an estimated 45,000 industries in São Paulo, only 29,000 have registered with the government for pollution-control purposes. Of those that have registered, 80 percent are considered polluting industries.

As the region's cities continue to grow, the problems of air and water pollution can only become worse, unless additional steps are quickly taken to control the emission of pollutants into the air and to require the treatment of wastes flowing into rivers and the ocean.

Hazardous Waste

Toxic wastes are byproducts of industrial growth. Developed nations produce most of the world's toxic waste. It is almost

impossible to dispose of these wastes, as they contaminate whatever environment they enter, be it the air, water or soil.

Locally produced hazardous waste is a growing problem in developing countries. Thousands of small industries largely escape regulation, while major polluters are considered too important to the economy to have their production costs raised by environmental protection measures. As mountains of waste grow, it becomes more difficult to deal with them.

The costs of cleaning up toxic and hazardous wastes are high—$10 billion for Germany, for example, and from $20 billion to $100 billion for the United States, according to recent estimates. Developing countries in Latin America may be unable to afford such a financial burden. But neither can they afford the mounting costs of hazardous waste on their population and environment.

Population

Every year, world population grows by over 90 million. Although growth rates are slowing, the momentum of population increase ensures that at least another 3 billion people will be added to the planet's total by the year 2025. Growth may not stop altogether for perhaps another century, by which time world population will be over 10 billion, twice the present level.

Most Latin American and Caribbean countries are still grappling with the consequences of rapid population growth and high fertility. Emigration from

Policy Choices: The Environment and National Debt

Much of the damage done to the global resource base is the consequence of individual decisions—to cultivate marginal land, to strip hillsides of trees for fuel, to graze land already showing signs of exhaustion. The willing and active cooperation of individuals in matters of family size, land use and other aspects of sustainable development is of critical importance. But frequently, people have little real choice because of their circumstances.

The accumulating national debt of developing nations, combined with rapid population growth, has forced many countries to the brink of bankruptcy. Latin American countries owe more money to foreign banks and development agencies than do the countries of any other region in the world. Their collective foreign debt is a staggering $400 billion. Servicing debt consumes, on average, 30 percent of all exports each year, and in some cases up to half of all exports.

Unable to live on the income from current production, poor nations must draw on their stock of natural resources to service debt and finance new ventures. Most developing countries have little choice but to export basic commodities instead of finished products. Handicapped by the international marketplace and unable to obtain more favorable terms of trade, they are compelled to increase their production for export. Mounting environmental damage is often a hidden price that developing countries pay for their exports. Moreover, outmoded production processes add to the burden on the environment.

While costly, the political and economic agendas of Latin American countries must take greater account of the need to conserve the region's ecological "capital"—its forests and diversity of species—and to pay for development from the "interest"—the sustainable husbandry of resources. One step will be to integrate the concept of "environmental accounting" in national planning and development activities. Another step will be to achieve an international economic and political structure that can promote and manage environmentally safe development and share in its costs. At the same time, reducing population growth—especially urban growth—will help to protect the environment from irreversible damage.

One of the consequences of rapid population growth is the shortage of adequate housing for residents of urban areas.

the Caribbean reduces the impact there.

It is true that fertility has declined in many countries of the region—by approximately one-third in the three largest countries, Brazil, Colombia and Mexico. Nevertheless, if current rates of growth continue, population would double in Mexico in about 29 years, and in 34 years in Brazil and Colombia. Only in a few countries has population growth slowed to less than 2 percent each year, with doubling times at current rates ranging from 41 to 100 years. Rapid population growth will remain a problem for several decades although growth rates are expected to decline further.

Reducing fertility is the key to slower population growth. In Latin America and the Caribbean, promoting the use of modern contraceptive methods is likely to have the greatest impact on fertility. Another factor that affects fertility indirectly is women's education. As women become better educated, they desire fewer children and are more likely to adopt and successfully use modern family planning methods. Other social and cultural factors that affect fertility by reducing people's desire for large families are those associated with national development—better health, particularly lower infant and child mortality, greater employment opportunities for women and improved economic status.

Countries that have successfully lowered fertility rates have in common the presence of strong family planning programmes that offer a wide range of contraceptive methods. These programmes are most successful when and where living standards are improving, literacy is relatively high, health conditions are comparatively good and the status of women is rising. However, even in the absence of social and economic improvement, family planning programmes can still contribute effectively to the health of mothers and infants through reduced fertility.

This article was part of a series of reports released by the Inter-American Parliamentary Group on Population and Development, March 1990.

World Citizens Must Change Their Ways

What do these six world citizens have in common?

• Surapong is a hard-working rice farmer in the Chao Phraya delta of Thailand. In years past, a small landholding such as his would barely yield a subsistence crop for its owner. But the recent introduction of irrigation and a quick-maturing rice variety now produces two crops annually on five hectares. A surplus of rice allows Surapong, his wife Thiamshai and their eight children to improve their diet and have some disposable income.

• Jerzy Polanski is a Polish coal miner at the Czerwone Zaglebie mine near Katowice, an industrial city 115 kilometres south of Warsaw. In common with coal miners around the world, he feels he is underpaid for his hazardous and dirty work. Last year the young bachelor helped organize a strike for better wages, but the modest increase he received as a result still produces little more than the basic necessities of life.

• José Gomez is a campesino engaged in shifting agriculture in Ecuador's Oriente region. Twenty years ago, José and his wife Elvia left the overpopulated Andean highlands to try their luck in the piedmont area east of the Andes. José, Elvia and their six children eke out an existence with the maize that is produced by slash-and-burn agriculture.

• Dr. John Smith, a North American doctor, practices gerontology in Washington, D.C.. He unfailingly calls on his elderly patients, a fact that endears him to his community. His medical practice permits his wife Carol to have a car to drive to her job.

• Charles Waddington is a prosperous New Zealand dairy farmer in the upper half of the North Island. His 60 dairy cows and fine cattle contribute to the nation's important butter and meat exports. Waddington, his wife Emily and their four children are all well-educated and civic-minded.

• Fred Garbrah, a Ghanaian businessman, owns a pharmacy in Accra. Renewed Ghanaian economic activity has allowed Mr. Garbrah to import a wider range of goods, including a few luxury items for his neighbourhood clients. He tends the store long hours with his wife Hannah and their seven children.

The six people described share one thing in common: their activities contribute to the "greenhouse effect" that threatens to change drastically the Earth's climate.

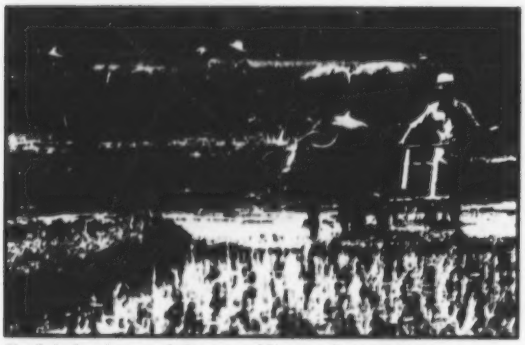
Growing rice is an absolute necessity for Surapong, the Thai farmer, and billions of other people, mostly in Asia. But the action of rice growing in water generates methane, one of the

Hectare
1 hectare = 2.47 acres

Kilometre
1 kilometre = 0.6214 mile

"In the 300 years or so that have encompassed the agricultural and industrial revolutions, man has begun to replace nature as the engine of climate change."

Mostafa K. Tolba,
Executive Director
of the United Nations
Environment Programme



Both irrigation and the use of livestock contribute to global warming.

most potent greenhouse gases. Surapong's improved irrigation of his two annual crops adds methane, a gas estimated to represent roughly 18 per cent of man-induced greenhouse gases, to the atmosphere. And rice cultivation is thought to create 20 per cent of all methane gases.

Coal mines, such as the one where Jerzy Polanski works, produce 6 per cent of all methane gases. In addition, the burning of coal creates carbon dioxide, which represents about half of all the greenhouse gases in the atmosphere.

José Gomez' simple slash-and-burn agriculture in Ecuador triggers a variety of pollution-causing effects. The burning of the vegetation emits carbon dioxide and nitrous oxide, on the one hand, and, on the other, destroys the forests that convert carbon dioxide into oxygen. Termites, which often attack the debris left by the clearing, produce methane gas in surprisingly large quantities. On a global basis, deforestation now pours 20 per cent of the carbon dioxide annually added to the atmosphere—and the percentage is rising.

Dr. and Mrs. Smith's and their compatriots' automobiles are a major source of pollution in the United States. Cars and light trucks account for one-third of all U.S. carbon dioxide emissions. The annual emission from Dr. Smith's car alone is estimated at more than five tons of carbon dioxide. Further, the single largest U.S. use of chloroflourocarbons is for automobile air conditioners.

Charles Waddington's fine animals fall into the category of "managed ruminants," which, according to the Food and Agriculture Organization, include 1.3 billion cattle, 1.2 billion sheep, 500 million goats, 100 million buffalo and 19 million camels. Because of the unique characteristic of a "fore-stomach," in which methanogenic bacteria create a "gas factory," ruminants produce about 15 per cent of all the world's methane gas emissions. In addition, the land cleared for Mr. Waddington's cattle range deprives the atmosphere of trees needed to absorb carbon dioxide.

Fred Garbrah's pharmacy sells aerosol products, including deodorants and hairspray. Chlorofluorcarbons, the "magic" ingredient in aerosol propellants, refrigerants and a variety of other common products, contribute 25 per cent of all greenhouse gases released into the atmosphere. Chlorofluorocarbons are second only to nitrous oxide in terms of lifespan, lasting 75 to 100 years in

the atmosphere.

Our six world citizens suggest the complex variety of polluters. In common with many people everywhere, they pursue occupations that either are considered productive or represent the only course of survival open to them. A few among us are rank despoilers; the vast majority of people, however, simply do not relate their personal consumption and activities to the problems of the environment. What could these six individuals do to curb their contributions to the "greenhouse effect?"

Rice is essential for many Third World countries, mainly in Asia. However, the United Nations Environment Programme (UNEP) contends that Surapong's method of rice cultivation over the long haul should be altered to reduce methane gas emission. And others note that Surapong and Thiamshai could participate in Thailand's excellent family planning programme to hold down demand for more and more rice to feed more and more mouths. Scientists estimate that by the year 2000, rice production will have to top 1987's output by 65 per cent just to keep pace with the current population growth rate.

Dr. Smith, although he may not be fully aware of it, does have the option of a more environmentally sensitive lifestyle. He could insulate his house to save energy, abstain from buying items containing chlorofluorocarbons, separate his garbage for recycling, plant trees in his backyard, support environmentally responsible corporations and use his influence in the community to lobby for the reduction of greenhouse gases.

Among energy-saving options, the Smiths, apart from the doctor's essential house calls, could choose to drive their cars less. They could also drive more efficient cars. More than 80 per cent of American workers disdain public transport and commute to their job by car. The U.S. has nearly 200 million motor vehicles, and one-fifth of all households have three cars or more.

Jerzy Polanski would have to be lucky to escape his pollution-making profession, but the mine management, in theory at least, could install new techniques to capture the operation's methane emissions before they are released into the atmosphere, and the Polish government could seek alternative energy sources to the burning of fossil fuel. The miner's union activities for the most part are driven by a desire to have a car and all the other luxuries of the industrialized world.

José Gomez seemingly is ensnared in the same cycle of destruction in which millions of Third World people find them-

Automobiles release chlorofluorocarbons and carbon dioxide into the atmosphere.

selves. But somehow a way has to be found to reduce the loss of tropical forests that now occurs at the rate of 12 million hectares annually.

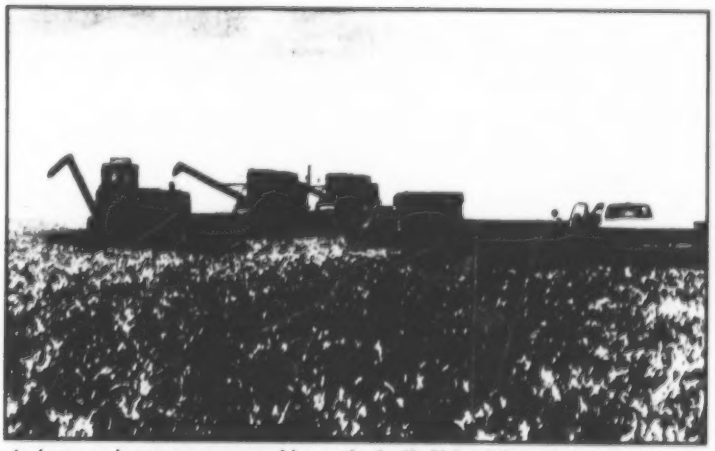
Charles Waddington, a well-off member of a wealthy country, has many of the same options to change his lifestyle that Dr. Smith has. In addition, raising cows and cattle for butter and meat raises its own questions. It takes about seven calories of grain to create one calorie of meat in cattle. In a more perfect world, might he raise grain, or leave the land in needed forest?

The margin of profit from Fred Garbrah's store is slim and the only source of income for the whole family. And a long period of austerity has created pent-up demand for luxury items in Ghana. But Mr. Garbrah hasn't tried, or even thought about trying, to sell more environment-friendly products.

The use of computer models to predict the future, an increasingly recognized and sophisticated way of projecting available data, has led to various "scenarios" about the ramifications of climate change.

The scenarios have found tropical and subtropical regions, where most developing nations are, to be hardest hit, with dry areas like the Sahel becoming drier and humid areas like the Amazon suffering more intense tropical storms. Lands within 35 degrees north and south of the equator would experience a drastic drop in food production. Among other problems, humid conditions would breed all sorts of pests and disease.

In temperate and higher latitudes, UNEP concludes, "winters might be shorter, wetter and warmer, summers longer, hotter and drier, particularly in mid-continental areas." The U.S. mid-western breadbasket, for instance, would become a dust bowl. Areas in high latitudes, such as Siberia, Canada, and Scandinavia, would experience substantial increases in temperature.



An increase in temperature could turn the fertile U.S. Midwest into a dust bowl.

José Gomez and other subsistence farmers without resources and know-how would have increasing difficulty trying to adjust to the climate changes that would call for different crops and substantial pest controls. Charles Waddington

probably could make expensive adaptations at his ranch, but many of his overseas markets would become less and less able to pay for luxury food imports. Surapong's rice cultivation would be affected by flooding and pests; and disease might plague the crowded Chao Phraya delta.

As widening desertification would end Ghana's new-found prosperity, Fred Garbrah's business would be strangled by a profound economic crisis. Dr. Smith would swelter in Washington's increasingly hot summers and live in a capital besieged by floods and climate change. Jerzy Polanski would find less demand for Polish coal and higher prices of food and other items.

Global warming could trigger increased thermal expansion and glacier melt that could lift the seas by 20 centimetres to 1.5 metres by the midpoint of the 21st century. Roughly half of the world's total population lives within 60 kilometres of the water's edge, a fact that makes both the developing and the developed world vulnerable to rising water.

Holland has demonstrated that water can be controlled—but at great expense. The U.S. Environmental Protection Agency estimates that it would cost between $73 billion and $111 billion to protect the U.S. coasts against a 3-foot rise in the sea level. A country like Bangladesh, already plagued by floods and sea surges, simply does not have the money needed to ward off an expanding ocean.

Why should such average world citizens as Surapong, Jerzy Polanski, José Gomez, Dr. John Smith, Charles Waddington and Fred Garbrah worry about predictions of greenhouse gases in the atmosphere, unprecedented floods, a hole in the ozone shield, rising oceans and the rest? After all, experts cannot say with certainty that global warming will devastate the world. Data could be wrong, computer models poorly fashioned, the atmosphere might experience unforeseen natural phenomena that balance off pollution or someone may invent magic remedies.

The world's informed leadership finds three compelling arguments for taking action now. Argument 1: UNEP and other scientific observers point out that the world cannot wait for positive proof that a potentially irreversible climate change has been set in motion. Governments spend vast sums of money for defence on the off-chance that a neighbour will cause a war, so why not defend against the strong possibility of climate change invasion?

Argument 2: The process that leads to the pollution of the

atmosphere also leads to the pollution of the Earth's surface. Even if global warming does not occur, the degradation of the Earth's environment is reason enough to adopt a system of sustainable development. In recent years the world has seen one-third of its total croplands lost or degraded by soil erosion, waterlogging and toxicity; mounting health problems in polluted and overcrowded cities; increasingly polluted bodies of water; and coastal lands made increasingly vulnerable to floods and coastal water surges.

Argument 3: All scenarios on global warming show that significant climate change will occur over a period that parallels the projected doubling of the world's population, or from 1990 to 2075. Most of the population increase will take place in the Third World, thereby upping those nations' overwhelming obligation to feed, care for, educate and find jobs for their peoples. In addition, more people represent increased demand for energy and products that presently lead to pollution. Even if family planning is made available worldwide, man will have to make sure that economic progress does not exhaust non-renewable resources.

"If current trends continue," warns UNEP, "the developing countries could become the leading contributors to global warming in the coming decades. Global warming will affect everybody, and perhaps most severely the developing countries because they lack the finances and technology to cope with climate change.

Our six world citizens are united by the common challenge of a shared danger, but finding a shared solution will be the problem. Somehow people such as Dr. John Smith and Charles Waddington will have to reduce their rampant pollution and help their Third World neighbours achieve sustainable development. All nations will have to encourage energy efficiency, a key to reducing carbon dioxide production.

Jerzy Polanski will have to tone down aspirations for a U.S.-style consumer society. And Surapong, José Gomez and Frank Garbrah must do what they can to reduce pollution and not let their countries join the ranks of the mindless contributors to global warming.

The challenge of finding agreement on the problem of global warming is daunting. But we can take the first step of providing a platform for information and dialogue.

"World Citizens Must Change Their Ways" was written for the "Global Edition" by Winthrop P. Carty of the Population Reference Bureau.

Glossary

Acid Rain. Rain that has become polluted from falling through air pollutants and dissolving them. The main pollutant is sulfur dioxide, released during the burning of fossil fuels.

Age Structure. Proportion of the population, or the number of people of each sex, at each age level in a population.

Agro-management. The control of agricultural areas, including soil and water.

Aquifer. An underground bed of rock, sand or gravel that holds water and transmits it to wells or springs.

Arable. Land that can be plowed or tilled easily.

Bayou. A marshy inlet or outlet or a lake or river, etc.

Bilharzia. A disease in tropical countries, especially Egypt, where the blood of humans is infested with worms. Humans contract the disease by drinking or bathing in infested waters.

Biogas. A gas containing methane and carbon dioxide. It is produced by decaying organic matter, especially manure and crop residues.

Biosphere. The part of the earth, including the air and water, that can support life.

Birth Rate (or Crude Birth Rate). The number of births per 1,000 population in a given year.

Campesino. A landless farmer from a rural area in Latin America.

Carbon Cycle. The movement of carbon (in different chemical forms) from the environment to organisms and back to the environment.

Carbon Dioxide. A heavy colorless gas that is exhaled by animals and absorbed by plants. Responsible for about half of global warming. The burning of fossil fuels and deforestation releases carbon dioxide into the atmosphere.

Carrying Capacity. The greatest number of living species (including humans) that can be supported in an area given its environmental condition.

Cash Crops. A crop grown primarily for the purpose of selling for profit.

Cassava. A plant with edible roots. It is an important source of starch and a major crop in the tropics.

Catchment Basin. The area drained by a river or river system. The catchment is where rain water initially falls. This water then flows to a river.

Char. Islands formed by the natural build-up of sand and silt in a delta area.

Chlorofluorocarbons (CFCs). The main cause of ozone layer depletion accounting for about 20 percent of global warming. CFCs are industrial chemicals used in refrigeration and air conditioning, aerosols and packaging.

Cholera. An infectious, sometimes fatal, disease marked by severe diarrhea and vomiting, spread through drinking unsanitary water.

Cyclical. Recurring on a regular basis.

Death Rate (or Crude Death Rate). The number of deaths per 1,000 population in a given year.

Deforestation. The loss of trees due to overcutting of forests. One consequence of deforestation is soil erosion, which results in the loss of protective soil cover and the water-holding capacity of the soil. The main causes are farming, logging, cattle ranching, development projects and population growth. Massive deforestation leads to increased carbon dioxide emissions into the atmosphere.

Delta. Islands and sandbars made from sediments dropped from rivers flowing into a still body of water such as a lake, sea or ocean.

Demographer. A person who studies human populations, including their size, composition, distribution, density, growth and characteristics that cause changes in these factors.

Desertification. The process by which semi-arid grassland becomes desert. This is usually caused by overgrazing, drought and changing climate.

Development. Meeting the basic needs (economic, health, and so forth) of people, and improving the standard of living in a society.

Drought. An extended time period in which there is no rain in an area. The land becomes dry, water sources dry up and crops either die or cannot grow.

Dysentery. An epidemic disease characterized by severe diarrhea and abdominal pain. Usually caused by bacterial contamination of food or water.

Ecosystem. The community of plants and animals interacting with one another and the environment.

Emigration. The process of leaving one country or area to take up residence in another.

Endemic. To be native of a particular people or country.

Exodus. A mass departure. Many people leaving the same place within the same time period.

Fallow. To leave land untilled or unsowed after plowing. This allows it to regain its nutrients, making it more suitable for raising crops.

Feddan. An Egyptian unit of area equal to 1.038 acres.

Fertility. The actual reproductive performance of an individual, a couple, a group or a population.

Finite Resources. Resources that are limited in quantity. When they are all used they can not be replaced.

Gene Pool. All hereditary information for a reproducing population of a particular species.

Greenhouse Gas. Gases whose emissions contribute to the greenhouse effect because they trap heat inside the atmosphere. Examples are methane, carbon dioxide, chlorofluorocarbons, nitrous oxide and others.

Greenhouse Effect. A warming of the global climate caused by the increased release of carbon dioxide and other "greenhouse gases" into the Earth's atmosphere.

Gross Domestic Product (GDP). A measure of the total output of goods and services produced by residents and non-residents of a country.

Gross National Product (GNP). The total value in current dollars of all goods and services produced by a country during a year. Includes GDP.

Growth Rate. (See Population Growth Rate.)

Habitat. The place where a plant or animal species naturally lives and grows.

Humus. A mixture of decaying organic matter and inorganic compounds in the topsoil. This helps to hold water and nutrients so plant roots can absorb them.

Hydroelectricity. Electric energy produced by falling water spinning a turbine generator.

Hydrostatic. Concerned with the characteristics of fluids.

Immigration. The process of entering one country from another to live permanently.

Infant Mortality Rate. The number of deaths to infants under one year of age in a given year per 1,000 live births in that year.

Infrastructure. The foundation on which economic development is based. Includes the transportation network, communications system, electricity, water supply, and so forth, of a nation or community.

Irrigation. To supply crops with water in excess of what they would get from natural rainfall. Water for irrigation comes from rivers, lakes or reservoirs; channels dug by man; drains built by man or pumped from underground water sources.

Land Degradation. To lower the quality of the land making it less suitable for growing crops or raising livestock. Land degradation is caused by overcropping, overgrazing and using farming methods that make the land less fertile.

Less Developed Country (LDC) also called Developing or Third World. A country that has low levels of average wealth, industrialization and modernization and often high levels of population growth and people employed in agriculture. Most are located in the tropical (low) latitudes in Africa, Asia and Latin America.

Life Expectancy. The average number of years a person can expect to live at the time of birth.

Mangroves. Salt tolerant trees that dominate as much as 70 percent of low-lying tropical coastlines at the outlets of rivers. They provide a habitat for fish and plants, as well as wood, fuel and charcoal.

Marginal Land. Land that is less fertile and will therefore have lower crop yields than more fertile soil unless more fertilizers are used.

Mega-city. Large cities. Sometimes defined as cities with over 5 million inhabitants.

Methane. One of the "greenhouse gases" that accounts for about 16 percent of the warming effect. Methane comes from decomposition in irrigated fields and the guts of livestock, among other sources.

Momentum of Population Increase. (See Population Momentum.)

Monsoon. A pattern of seasonally changing winds with rain that dominates life in the South Asian region.

More Developed Country (MDC) also called Developed or Industrialized. Countries that have higher levels of per capita income, industrialization and modernization. They usually have lower levels of population growth. The "more developed" region of the world according to the United Nations includes Europe, Canada, the United States, Australia, Japan, New Zealand and the Soviet Union.

Natural Increase. The surplus (or deficit) of births over deaths in a population in a given time period.

Newly Industrialized Country (NIC). Countries that are developing rapidly. These include Saudi Arabia, Kuwait, the United Arab Emirates and Bahrain in the Middle East and Taiwan, South Korea, Hong Kong and Singapore in Southeast Asia.

Nitrous Oxide. Gas emitted by humus decomposing rapidly after forest clearance, and by the breakdown of nitrogen fertilizers.

Oasis. A small, isolated plot of fertile land in the middle of barren or desert land. Usually has trees, greenery and a local water supply.

Ozone Layer. Chemical layer that protects living things on earth by filtering harmful radiation from the sun.

Paraffin. British term for kerosine.

Perennial. Everlasting.

Photosynthesis. Takes place in the cells of green plants. Energy from the sun is used to combine carbon dioxide and water to produce oxygen, which is then emitted into the air for organisms to breathe.

Population Explosion. A phrase used to describe rapid population growth in this century. This is caused by the world birth rate being much higher than the world death rate.

Population Growth Rate. The rate at which a population is increasing (or decreasing) in a given time period, expressed as a percentage of the base population.

Population Momentum. The tendency for population growth to continue beyond the rate that is needed to exactly replace the dying population because of a relatively high concentration of people in the childbearing years.

Potable. A word used to describe a liquid that is suitable for drinking.

Refugee. A person who flees to a foreign country or place to avoid persecution because of race, religion or political beliefs in his own country or area. An environmental refugee leaves his country because he cannot survive given conditions on the land.

Sahel. A strip of land on the southern edge of the Sahara Desert in North Africa. This area was savannah grassland at one time, but because of prolonged drought, it is threatened with desertification.

Salinization. The build-up of salt in the soil. Too much salt build-up can damage and kill plants and destroy the soil's ability to grow other plants.

Sedimentation (or Siltation). Rock, gravel and other matter in a body of water (such as a river) that is deposited onto the floor of that body of water.

Semi-arid. Characterized by light rainfall and high evaporation, the growth of short grasses and dry farming of limited yield.

Shanty Town. Area where many of the poorer people of a city live. They are often on the outskirts of large Third World cities and have very little or no sanitation, water or electricity. Many of the houses are made of cardboard.

Silt. Sedimentary rock material whose particles are finer than grains of sand, but larger than clay particles.

Slash-and-Burn Agriculture. A type of agriculture where all the trees and vegetation in a patch of forest are cut down and then the area is burned. The ashes from the burning add nutrients to the soil, and then crops are planted between the stumps. The plots are abandoned after a few years because of loss of soil fertility, and allowed to grow over again with trees and vegetation. This allows the natural vegetation and soil to recover.

Squatter Settlement. An area inhabited by individuals who have no legal right or title to the land.

Subsistence Farmer. One who farms to grow food in order to stay alive. Most of what is produced is consumed by the farmer and his family, with little or nothing left over to be sold at the market.

Sulfur Dioxide. A colorless gas produced during the burning of fossil fuels that are contaminated with sulfur compounds.

Sustainable Development. Practices in agriculture, economic development, health and education that lead to progress and meet the needs and desires of the current generation without decreasing the ability of future generations to meet their needs.

Tailings. Rock and other materials removed as waste when minerals are mined and mineral deposits are processed. These wastes are usually dumped on the ground or into ponds.

Third World. (See Less Developed Country.)

Typhoid (or Typhoid Fever). A contagious disease characterized by fever, headache, the eruption of rose spots, diarrhea and inflammation of the intestines.

Upland. Marginal lands with slopes of 18 percent or higher, lands within mountain zones, and lands that are generally hilly to mountainous in terrain.

Urbanization. Growth in the proportion of a population living in areas with a population of more than 2,500 people (a city).

Water Cycle (Hydraulic Cycle). The movement of water through the environment from the air to earth then back again. Events in the water cycle include evaporation and precipitation.

Watershed. Land area that delivers run-off water, sediment and dissolved substances to a major river and its branches.

The essays in this book use both British and American terms. Here are some examples of different spellings.

British	American
centre	center
defence	defense
diarrhoea	diarrhea
kilometre	kilometer
labour	labor
metre	meter
mould	mold
neighbour	neighbor
per cent	percent
practise	practice
programme	program
tonnes	tons

1990 World Population Data Sheet

Prepared by Carl Haub, and Mary Mederios Kent and Machiko Yanagashita

	Population Estimate mid-1990 (millions)	Birth Rate (per 1,000 pop.)	Death Rate (per 1,000 pop.)	Natural Increase (annual, %)	Population "Doubling Time" in Years (at *current* rate)	Population Projected to 2000 (millions)	Population Projected to 2020 (millions)	Infant Mortality Rate*	Total Fertility Rate*	%Population Under Age 15/65+	Life Expectancy at Birth (years)	Urban Population (%)	Data Availability Code*	%Married Women Using Contraception (Total/Modern)	Government View of Fertility Level (H = too high, S = satisfactory, L = too low)	Per Capita GNP, 1988 (US$)
WORLD	**5,321**	**27**	**10**	**1.8**	**39**	**6,292**	**8,228**	**73**	**3.5**	**33/6**	**64**	**41**		**55/48**		**$ 3,470**
MORE DEVELOPED	**1,214**	**15**	**9**	**0.5**	**128**	**1,274**	**1,350**	**16**	**2.0**	**22/12**	**74**	**73**		**69/54**		**15,830**
LESS DEVELOPED	**4,107**	**31**	**10**	**2.1**	**33**	**5,018**	**6,878**	**81**	**4.0**	**36/4**	**61**	**32**		**52/48**		**710**
LESS DEVEL. (Excl. China)	**2,987**	**35**	**11**	**2.4**	**29**	**3,736**	**5,382**	**91**	**4.8**	**40/4**	**59**	**36**		**41/34**		**870**
AFRICA	**661**	**44**	**15**	**2.9**	**24**	**884**	**1,481**	**109**	**6.2**	**45/3**	**52**	**31**		**–/–**		**600**
NORTHERN AFRICA	**144**	**38**	**10**	**2.8**	**25**	**183**	**268**	**87**	**5.2**	**43/4**	**59**	**41**		**31/27**		**1,110**
Algeria	25.6	40	9	3.1	22	32.7	45.6	74	6.1	46/4	60	43	B	–/–	H	2,450
Egypt	54.7	38	9	2.9	24	69.0	101.9	90	4.7	41/4	60	45	B	38/35	H	650
Libya	4.2	38	7	3.1	22	5.6	8.5	69	5.5	44/3	66	76	C	–/–	S	5,410
Morocco	25.6	35	10	2.6	27	31.4	43.3	82	4.8	42/4	61	43	B	36/29	H	750
Sudan	25.2	45	16	2.9	24	33.6	54.6	108	6.4	45/3	50	20	C	5/4	S	340
Tunisia	8.1	28	7	2.0	34	10.1	13.8	59	4.1	39/4	65	53	B	50/40	H	1,230
Western Sahara	0.2	49	23	2.5	28	0.2	0.4	–	–	–/–	–	–	D	–/–	–	–
WESTERN AFRICA	**206**	**47**	**17**	**3.0**	**23**	**279**	**481**	**119**	**6.8**	**48/2**	**48**	**30**		**8/2**		**340**
Benin	4.7	51	19	3.2	22	6.6	11.7	110	7.0	47/3	47	39	C	9/1	S	340
Burkina Faso	9.1	50	18	3.2	21	12.5	23.0	126	7.2	48/4	51	8	C	–/–	H	230
Cape Verde	0.4	38	10	2.8	25	0.5	0.8	66	5.2	42/5	61	27	B	–/–	H	–
Côte d'Ivoire	12.6	51	14	3.7	19	18.5	35.4	96	7.4	49/2	53	43	C	3/1	S	740
Gambia	0.9	47	21	2.6	27	1.1	1.7	143	6.4	44/3	43	21	C	–/–	H	220
Ghana	15.0	44	13	3.1	22	20.4	33.9	86	6.3	45/3	55	32	B	13/5	H	400
Guinea	7.3	47	22	2.5	28	9.2	14.4	147	6.2	43/3	42	22	C	–/–	H	350
Guinea-Bissau	1.0	41	20	2.1	33	1.2	2.0	132	5.4	41/4	45	27	C	–/–	H	*160*
Liberia	2.6	45	13	3.2	22	3.7	6.5	83	6.4	46/3	56	43	B	6/6	H	*450*
Mali	8.1	52	22	3.0	23	10.7	19.2	117	7.2	47/3	45	18	B	5/1	S	230
Mauritania	2.0	46	19	2.7	25	2.7	4.5	127	6.5	44/3	46	35	C	1/–	S	480
Niger	7.9	51	21	3.0	23	11.1	20.6	135	7.1	47/3	45	16	C	–/–	H	310
Nigeria	118.8	48	17	2.9	24	160.8	273.2	121	6.5	45/2	48	31	C	5/1	H	290
Senegal	7.4	46	19	2.7	26	9.7	15.2	128	6.4	44/3	46	36	B	11/2	H	630
Sierra Leone	4.2	48	23	2.5	28	5.4	8.9	154	6.5	44/3	41	28	C	–/–	H	240
Togo	3.7	50	14	3.6	19	5.2	9.9	114	7.2	49/2	55	22	B	34/3	S	370
EASTERN AFRICA	**199**	**47**	**17**	**3.0**	**23**	**273**	**481**	**116**	**6.7**	**47/3**	**50**	**18**		**–/–**		**230**
Burundi	5.6	48	15	3.2	22	7.7	13.7	114	7.0	45/3	51	5	C	9/1	H	230
Comoros	0.5	47	13	3.4	20	0.7	1.3	94	7.1	48/3	55	23	C	–/–	H	440
Djibouti	0.4	47	18	3.0	23	0.6	1.0	122	6.6	46/3	47	78	D	–/–	S	–
Ethiopia	51.7	44	24	2.0	34	70.8	126.0	154	6.2	46/4	41	11	C	–/–	H	120
Kenya	24.6	46	7	3.8	18	35.1	60.5	62	6.7	50/2	63	20	C	27/18	H	360
Madagascar	12.0	46	14	3.2	22	16.6	29.6	120	6.6	45/3	54	22	C	–/–	S	180
Malawi	9.2	52	18	3.4	20	11.8	22.0	130	7.7	48/3	49	14	B	7/1	H	160
Mauritius	1.1	19	7	1.3	54	1.2	1.3	25.2	2.0	30/5	68	41	A	75/45	S	1,810
Mozambique	15.7	45	19	2.7	26	20.4	31.9	141	6.4	44/3	47	19	C	–/–	S	100
Reunion	0.6	24	6	1.8	39	0.7	0.8	14	2.4	32/5	71	98	B	–/–	–	–
Rwanda	7.3	51	17	3.4	20	10.4	19.7	122	8.3	49/2	49	6	C	10/1	H	310
Seychelles	0.1	25	8	1.7	41	0.1	0.1	*17.0*	2.7	36/6	70	52	B	–/–	H	3,800
Somalia	8.4	51	20	3.1	23	10.4	18.7	132	6.6	47/3	45	33	C	–/–	S	170
Tanzania	26.0	51	14	3.7	19	36.5	68.8	106	7.1	49/2	53	19	C	–/–	H	160
Uganda	18.0	52	17	3.6	20	25.1	42.2	107	7.4	49/2	49	9	B	5/3	H	280
Zambia	8.1	51	14	3.8	18	11.6	22.0	80	7.2	49/2	53	45	C	–/–	H	290
Zimbabwe	9.7	42	10	3.2	22	13.1	20.9	72	5.8	45/3	58	25	B	43/36	H	660

(–) data unavailable or inapplicable

*Infant deaths per 1,000 live births

	Population Estimate mid-1990 (millions)	Birth Rate (per 1,000 pop.)	Death Rate (per 1,000 pop.)	Natural Increase (annual, %)	Population "Doubling Time" in Years (at *current* rate)	Population Projected to 2000 (millions)	Population Projected to 2020 (millions)	Infant Mortality Rate[a]	Total Fertility Rate[b]	%Population Under Age 15/65 +	Life Expectancy at Birth (years)	Urban Population (%)	Data Availability Code[c]	%Married Women Using Contraception (Total/Modern)	Government View of Fertility Level (H = too high, S = satisfactory, L = too low)	Per Capita GNP, 1988 (US$)
MIDDLE AFRICA	**68**	**45**	**16**	**3.0**	**23**	**91**	**156**	**118**	**6.1**	**45/3**	**50**	**37**		**–/–**		**420**
Angola	8.5	47	20	2.7	26	11.1	18.5	137	6.4	45/3	45	25	C	–/–	H	–
Cameroon	11.1	42	16	2.6	26	14.5	23.5	125	5.8	44/3	50	42	C	2/1	H	1,010
Central African Republic	2.9	44	19	2.5	27	3.7	5.9	143	5.6	42/3	46	35	C	–/–	H	390
Chad	5.0	44	20	2.5	28	6.2	9.4	132	5.9	43/4	46	27	D	–/–	S	160
Congo	2.2	44	14	3.0	23	3.0	5.0	113	6.0	45/3	53	40	C	–/–	L	930
Equatorial Guinea	0.4	43	17	2.6	27	0.5	0.8	120	5.5	43/4	50	60	C	–/–	L	350
Gabon	1.2	39	16	2.2	31	1.6	2.6	103	5.0	33/6	52	41	C	–/–	L	2,970
Sao Tome and Principe	0.1	36	9	2.7	25	0.2	0.3	61.7	5.4	42/5	65	38	A	–/–	S	*280*
Zaire	36.6	47	14	3.3	21	50.3	90.0	108	6.2	46/3	53	40	C	–/–	S	170
SOUTHERN AFRICA	**45**	**36**	**9**	**2.7**	**26**	**59**	**95**	**61**	**4.7**	**40/4**	**62**	**53**		**45/42**		**2,150**
Botswana	1.2	40	11	2.9	24	1.6	2.2	64	5.3	46/3	59	22	B	33/32	H	*1,050*
Lesotho	1.8	41	12	2.8	24	2.4	3.9	100	5.8	43/4	56	17	C	5/2	H	410
Namibia	1.5	44	12	3.2	22	2.1	3.9	106	6.1	45/3	56	51	C	–/–	–	–
South Africa	39.6	35	8	2.7	26	51.5	83.5	55	4.5	40/4	63	56	B	48/45	H	2,290
Swaziland	0.8	46	15	3.1	22	1.1	1.8	130	6.2	47/2	50	26	B	20/17	H	790
EUROPE	**501**	**13**	**10**	**0.3**	**268**	**515**	**516**	**12**	**1.7**	**20/13**	**74**	**75**		**73/47**		**12,170**
NORTHERN EUROPE	**84**	**14**	**11**	**0.2**	**286**	**86**	**88**	**9**	**1.8**	**19/15**	**75**	**85**		**80/73**		**14,300**
Denmark	5.1	12	12	0.0	(–)	5.2	4.9	7.8	1.6	18/15	75	84	A	63/59	S	18,470
Finland	5.0	13	10	0.3	239	5.0	4.9	5.9	1.7	19/13	75	62	A	80/77	S	18,610
Iceland	0.3	19	7	1.1	61	0.3	0.3	*6.2*	2.3	25/10	78	89	A	–/–	S	20,160
Ireland	3.5	15	9	0.6	108	3.5	3.4	9.7	2.2	28/11	74	56	A	60/–	S	7,480
Norway	4.2	14	11	0.3	231	4.3	4.3	8.4	1.8	19/16	76	71	A	71/64	S	20,020
Sweden	8.5	14	11	0.2	311	8.8	9.0	5.8	2.0	18/18	77	83	A	78/71	S	19,150
United Kingdom	57.4	14	12	0.2	301	59.1	60.8	9.5	1.8	19/15	75	90	A	83/75	S	12,800
WESTERN EUROPE	**159**	**12**	**10**	**0.2**	**326**	**164**	**160**	**8**	**1.6**	**18/14**	**76**	**83**		**76/61**		**17,270**
Austria	7.6	12	11	0.1	1,155	7.7	7.6	8.1	1.4	18/15	75	55	A	71/56	S	15,560
Belgium	9.9	12	11	0.2	462	9.9	9.4	9.2	1.6	18/14	74	95	A	81/64	S	14,550
France	56.4	14	9	0.4	157	57.9	58.7	7.5	1.8	20/14	77	73	A	75/51	L	16,080
Germany, West	63.2	11	11	–0.0	(–)	65.7	62.3	7.5	1.4	15/15	76	94	A	78/68	L	18,530
Luxembourg	0.4	12	10	0.2	346	0.4	0.4	*8.7*	1.4	17/13	75	78	A	–/–	L	22,600
Netherlands	14.9	13	8	0.4	165	15.3	15.0	7.6	1.5	18/13	77	89	A	72/69	S	14,530
Switzerland	6.7	12	9	0.3	231	6.8	6.9	6.8	1.6	17/15	77	61	A	71/65	L	27,260
EASTERN EUROPE	**113**	**14**	**11**	**0.3**	**215**	**115**	**119**	**18**	**2.0**	**24/11**	**71**	**64**		**69/23**		**–**
Bulgaria	8.9	13	12	0.1	630	9.0	9.1	13.5	2.0	21/12	72	67	A	76/8	L	–
Czechoslovakia	15.7	14	11	0.2	289	16.3	17.0	11.9	2.1	24/11	71	75	A	66/25	S	–
Germany, East	16.3	13	13	0.0	6,930	15.5	15.0	8.1	1.7	19/13	73	77	A	–/–	L	–
Hungary	10.6	12	13	–0.2	(–)	10.6	10.4	15.8	1.8	21/13	70	60	A	73/62	L	2,460
Poland	37.8	16	10	0.6	122	38.9	41.7	16.2	2.1	26/10	71	61	A	75/26	S	1,850
Romania	23.3	16	11	0.5	141	24.5	26.0	25.6	2.3	25/9	70	54	B	56/6	–	–
SOUTHERN EUROPE	**145**	**12**	**9**	**0.3**	**250**	**150**	**149**	**14**	**1.5**	**21/12**	**75**	**66**		**67/30**		**6,850**
Albania	3.3	26	6	2.0	34	3.8	4.7	28	3.2	35/5	71	35	B	–/–	S	–
Greece	10.1	11	9	0.2	408	10.2	9.9	11.0	1.5	20/13	77	58	A	–/–	L	4,790
Italy	57.7	10	9	0.1	1,155	58.6	56.1	9.5	1.3	18/14	75	72	A	78/32	L	13,320
Malta	0.4	16	8	0.8	87	0.4	0.4	*8.0*	2.0	24/10	75	85	A	–/–	S	5,050
Portugal	10.4	12	10	0.2	301	10.7	10.7	14.9	1.6	22/13	74	30	A	66/33	S	3,670
Spain	39.4	11	8	0.3	247	40.7	40.7	9.0	1.5	22/13	77	91	A	59/38	S	7,740
Yugoslavia	23.8	15	9	0.6	114	25.1	26.3	24.5	2.0	23/9	71	46	A	55/12	S	2,680
USSR	**291**	**19**	**10**	**0.9**	**80**	**312**	**355**	**29**	**2.5**	**25/9**	**69**	**66**	**A**	**–/–**	**S**	**–**
NORTH AMERICA	**278**	**16**	**9**	**0.7**	**93**	**296**	**328**	**9**	**2.0**	**22/12**	**75**	**74**		**67/63**		**19,490**
Canada	26.6	14	7	0.7	96	29.3	33.1	7.3	1.7	21/11	77	77	A	73/69	S	16,760
United States	251.4	16	9	0.8	92	268.3	294.4	9.7	2.0	22/12	75	74	A	66/62	S	19,780

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ASIA	**3,116**	**27**	**9**	**1.9**	**37**	**3,718**	**4,805**	**74**	**3.5**	**34/5**	**63**	**29**		**56/51**		**1,430**
ASIA (Excl. China)	**1,997**	**31**	**10**	**2.1**	**33**	**2,438**	**3,308**	**88**	**4.1**	**38/4**	**60**	**33**		**45/38**		**2,140**
WESTERN ASIA	**132**	**36**	**8**	**2.8**	**24**	**175**	**283**	**71**	**5.2**	**41/4**	**64**	**58**		**37/19**		**2,860**
Bahrain	0.5	27	3	2.3	30	0.7	1.0	24	4.2	33/2	67	81	C	–/–	S	*6,610*
Cyprus	0.7	19	9	1.0	67	0.8	0.9	11	2.4	26/10	76	62	B	–/–	L	6,260
Gaza	0.6	50	7	4.3	16	0.8	1.4	55	7.0	50/3	65	–	C	–/–	–	–
Iraq	18.8	46	7	3.9	18	27.2	50.9	67	7.3	45/3	67	68	C	15/13	L	–
Israel	4.6	23	7	1.6	43	5.4	7.0	10.0	3.1	32/9	75	89	A	–/–	L	8,650
Jordan	4.1	41	6	3.5	20	5.7	9.7	54	5.9	46/2	69	64	C	27/21	H	1,500
Kuwait	2.1	27	2	2.5	28	2.9	4.6	15.6	3.7	37/1	73	94	A	–/–	S	13,680
Lebanon	3.3	28	7	2.1	33	4.1	5.8	49	3.7	40/5	68	80	D	–/–	S	–
Oman	1.5	46	13	3.3	21	2.1	3.8	100	7.2	46/3	55	9	D	–/–	S	5,070
Qatar	0.5	25	2	2.3	30	0.7	1.1	25	4.5	29/1	69	88	C	–/–	S	11,610
Saudi Arabia	15.0	42	8	3.4	20	22.0	42.2	71	7.2	45/3	63	73	D	–/–	S	6,170
Syria	12.6	45	7	3.8	18	18.0	32.6	48	6.8	49/4	65	50	C	20/15	S	1,670
Turkey	56.7	29	8	2.1	32	69.0	93.8	74	3.6	36/4	64	53	B	53/24	H	1,280
United Arab Emirates	1.6	23	4	1.9	36	2.0	2.6	26	4.8	31/2	71	81	C	–/–	S	15,720
Yemen, North	7.2	52	17	3.5	20	10.0	19.5	129	7.6	50/3	49	20	C	1/1	H	650
Yemen, South	2.6	48	14	3.4	20	3.6	6.4	110	7.0	48/3	52	40	C	–/–	H	430
SOUTHERN ASIA	**1,192**	**35**	**12**	**2.3**	**30**	**1,485**	**2,065**	**101**	**4.8**	**40/3**	**57**	**26**		**42/36**		**310**
Afghanistan	15.9	48	22	2.6	27	25.4	43.0	182	7.1	46/4	41	18	D	–/–	H	–
Bangladesh	114.8	39	14	2.5	28	146.6	201.4	120	4.9	43/3	54	13	B	33/26	H	170
Bhutan	1.6	38	17	2.1	32	1.9	2.7	128	5.5	38/4	48	5	C	–/–	S	*150*
India	853.4	32	11	2.1	33	1,042.5	1,374.5	95	4.2	39/3	57	26	B	48/41	H	330
Iran	55.6	45	10	3.6	20	75.7	130.2	91	6.3	45/3	63	54	C	–/–	S	–
Maldives	0.2	46	9	3.7	19	0.3	0.6	76	6.6	45/2	61	26	B	–/–	S	410
Nepal	19.1	42	17	2.5	28	24.3	37.5	112	6.1	42/3	52	7	B	15/15	H	170
Pakistan	114.6	44	13	3.0	23	149.1	251.3	110	6.7	44/4	56	28	B	8/7	H	350
Sri Lanka	17.2	21	6	1.5	47	19.4	24.0	22.5	2.3	35/4	70	22	A	62/41	H	420
SOUTHEAST ASIA	**455**	**29**	**8**	**2.1**	**34**	**547**	**721**	**70**	**3.6**	**38/4**	**61**	**27**		**46/39**		**–**
Brunei	0.3	29	3	2.5	27	0.3	0.4	11	3.6	37/3	71	59	B	–/–	S	*14,120*
Cambodia	7.0	39	16	2.2	31	8.5	11.9	128	4.5	36/3	49	11	D	–/–	L	–
East Timor	0.7	44	22	2.2	31	0.9	1.1	166	5.4	35/3	43	12	C	–/–	–	–
Indonesia	189.4	27	9	1.8	38	223.8	287.3	89	3.3	38/3	59	26	B	48/44	H	430
Laos	4.0	41	16	2.5	28	5.0	6.9	110	5.5	43/3	47	16	C	–/–	S	180
Malaysia	17.9	30	5	2.5	28	21.5	27.3	30	3.6	38/4	68	35	B	51/30	H	1,870
Myanmar (Burma)	41.3	33	13	2.0	34	49.8	67.7	97	4.2	37/4	55	24	C	–/–	S	–
Philippines	66.1	33	7	2.6	27	82.7	117.5	48	4.3	39/3	64	42	B	45/22	H	630
Singapore	2.7	20	5	1.5	47	3.0	3.4	6.9	2.0	23/6	73	100	A	74/59	L	9,100
Thailand	55.7	22	7	1.5	45	63.7	78.1	39	2.6	35/4	66	18	B	68/65	H	1,000
Viet Nam	70.2	33	8	2.5	28	88.3	119.5	50	4.2	42/4	66	20	B	20/20	H	–
EAST ASIA	**1,336**	**20**	**6**	**1.3**	**52**	**1,510**	**1,735**	**35**	**2.2**	**26/6**	**69**	**29**		**73/71**		**2,460**
China	1,119.9	21	7	1.4	49	1,280.0	1,496.3	37	2.3	27/6	68	21	B	74/73	H	330
Hong Kong	5.8	13	5	0.8	82	6.3	6.9	7.4	1.4	22/8	77	93	A	72/64	–	9,230
Japan	123.6	10	6	0.4	175	127.5	124.2	4.8	1.6	20/11	79	77	A	64/60	S	21,040
Korea, North	21.3	26	5	2.1	32	24.9	29.8	33	2.5	34/4	70	64	D	–/–	S	–
Korea, South	42.8	16	6	1.0	72	46.0	48.9	30	1.6	27/5	68	70	B	70/59	S	3,530
Macao	0.5	18	3	1.5	47	0.5	0.5	9	–	23/8	76	97	C	–/–	–	–
Mongolia	2.2	36	9	2.8	25	2.8	4.3	50	4.8	41/4	65	52	C	–/–	H	–
Taiwan	20.2	17	5	1.2	57	22.1	24.1	17	1.8	28/6	74	71	B	78/62	S	–

[a]Average number of children born to a woman during her lifetime. [c]A = complete data . . . D = little or no data

	Population Estimate mid-1990 (millions)	Birth Rate (per 1,000 pop.)	Death Rate (per 1,000 pop.)	Natural Increase (annual, %)	Population "Doubling Time" in Years (at *current* rate)	Population Projected to 2000 (millions)	Population Projected to 2020 (millions)	Infant Mortality Rate[a]	Total Fertility Rate[b]	%Population Under Age 15/65 +	Life Expectancy at Birth (years)	Urban Population (%)	Data Availability Code[c]	%Married Women Using Contraception (Total/Modern)	Government View of Fertility Level (H = too high, S = satisfactory, L = too low)	Per Capita GNP, 1988 (US$)
LATIN AMERICA	**447**	**28**	**7**	**2.1**	**33**	**535**	**705**	**54**	**3.5**	**38/5**	**67**	**69**		**55/48**		**1,930**
CENTRAL AMERICA	**118**	**32**	**6**	**2.5**	**27**	**145**	**196**	**51**	**4.1**	**42/4**	**67**	**61**		**49/42**		**1,640**
Belize	0.2	37	6	3.1	22	0.3	0.5	36	5.0	44/4	69	50	C	37/–	S	1,460
Costa Rica	3.0	29	4	2.5	28	3.8	5.3	17.4	3.3	36/5	76	45	A	70/58	H	1,760
El Salvador	5.3	35	8	2.7	26	6.5	8.8	54	4.4	45/4	62	43	C	47/45	H	950
Guatemala	9.2	40	9	3.1	23	11.8	17.6	59	5.6	46/3	63	40	B	23/18	H	880
Honduras	5.1	39	8	3.1	23	6.8	10.6	63	5.3	47/3	63	42	C	35/30	H	850
Mexico	88.6	30	6	2.4	29	107.2	142.1	50	3.8	42/4	68	66	B	53/45	H	1,820
Nicaragua	3.9	42	9	3.3	21	5.1	7.7	69	5.5	47/4	62	57	C	27/23	H	*830*
Panama	2.4	27	5	2.2	32	2.9	3.7	23	3.1	36/5	72	52	B	58/54	S	*2,240*
CARIBBEAN	**34**	**25**	**8**	**1.7**	**40**	**38**	**48**	**57**	**3.1**	**33/6**	**68**	**56**		**–/–**		**–**
Antigua and Barbuda	0.1	15	5	1.0	71	0.1	0.1	24	1.7	27/6	71	58	A	39/37	S	2,800
Bahamas	0.2	20	5	1.5	46	0.3	0.3	21.7	2.3	34/5	71	75	A	–/–	S	10,570
Barbados	0.3	16	9	0.7	100	0.3	0.3	16.2	1.8	28/11	75	32	A	47/45	S	5,990
Cuba	10.6	18	7	1.2	60	11.6	12.8	11.9	1.9	25/8	75	72	A	–/–	S	–
Dominica	0.1	26	5	2.1	33	0.1	0.1	14	2.7	34/7	75	–	B	49/47	H	1,650
Dominican Republic	7.2	31	7	2.5	28	8.6	11.0	65	3.8	39/3	66	52	B	50/47	H	680
Grenada	0.1	37	7	3.0	23	0.1	0.1	30	4.9	39/7	71	–	C	31/28	H	1,370
Guadeloupe	0.3	20	7	1.4	51	0.4	0.4	18.0	2.2	31/7	73	90	A	44/31	–	–
Haiti	6.5	35	14	2.2	32	7.8	11.4	122	5.1	40/5	53	26	B	7/4	H	360
Jamaica	2.4	22	5	1.7	41	2.7	3.5	16	2.4	37/6	76	49	B	51/48	H	1,080
Martinique	0.3	19	6	1.3	54	0.4	0.4	11	2.1	30/7	74	82	B	51/37	–	–
Netherlands Antilles	0.2	18	5	1.3	55	0.2	0.2	9	2.0	30/7	73	53	B	–/–	–	–
Puerto Rico	3.3	20	7	1.2	57	3.4	4.0	14.2	2.2	30/9	72	67	A	70/62	–	*5,540*
St. Kitts-Nevis	0.04	23	11	1.3	55	0.04	0.1	39.7	2.6	34/9	68	45	A	41/37	H	2,770
Saint Lucia	0.2	28	6	2.2	31	0.2	0.3	21.5	3.8	44/6	71	46	A	43/40	H	1,540
St. Vincent and the Grenadines	0.1	25	6	1.9	37	0.1	0.2	24.7	2.8	44/6	72	21	A	42/40	H	1,100
Trinidad and Tobago	1.3	27	7	2.0	34	1.7	2.4	13.7	3.1	34/6	70	64	A	53/44	H	3,350
TROPICAL SOUTH AMERICA	**247**	**29**	**8**	**2.1**	**33**	**298**	**396**	**59**	**3.5**	**37/4**	**65**	**71**		**60/49**		**2,020**
Bolivia	7.3	38	12	2.6	27	9.3	13.4	110	5.1	43/4	53	49	C	30/12	H	570
Brazil	150.4	27	8	1.9	36	179.5	233.8	63	3.3	36/4	65	74	B	65/56	S	2,280
Colombia	31.8	28	7	2.0	34	38.0	49.3	46	3.4	36/4	66	68	B	65/53	S	1,240
Ecuador	10.7	33	8	2.5	27	13.6	19.5	63	4.3	42/4	65	54	B	44/36	H	1,080
Guyana	0.8	25	5	1.9	36	0.8	1.1	30	2.8	37/4	67	33	B	31/28	S	410
Paraguay	4.3	35	7	2.8	25	5.5	8.4	42	4.6	41/4	67	43	B	45/29	S	1,180
Peru	21.9	32	8	2.4	29	26.4	35.1	76	4.1	38/4	65	69	B	46/23	H	*1,440*
Suriname	0.4	27	6	2.0	34	0.5	0.6	40	3.0	34/4	68	66	B	–/–	S	2,450
Venezuela	19.6	28	5	2.3	30	24.1	33.3	33	3.5	39/4	70	83	B	49/38	S	3,170
TEMPERATE SOUTH AMERICA	**49**	**21**	**8**	**1.4**	**51**	**55**	**68**	**28**	**2.8**	**33/8**	**71**	**85**		**–/–**		**2,320**
Argentina	32.3	21	9	1.3	54	36.0	43.5	32	3.0	34/9	71	85	B	–/–	S	2,640
Chile	13.2	22	6	1.7	41	15.3	19.0	18.5	2.5	31/6	71	84	A	–/–	S	1,510
Uruguay	3.0	18	10	0.8	87	3.2	3.6	22.3	2.4	26/12	71	87	A	–/–	L	2,470
OCEANIA	**27**	**20**	**8**	**1.2**	**57**	**31**	**38**	**26**	**2.8**	**27/8**	**72**	**70**		**58/48**		**9,550**
Australia	17.1	15	7	0.8	90	19.1	22.9	8.7	1.8	22/11	76	86	A	67/47	S	12,390
Fiji	0.8	27	6	2.2	32	0.9	1.2	21	3.3	38/3	63	39	B	41/35	H	1,540
French Polynesia	0.2	31	6	2.5	27	0.2	0.3	23	3.9	37/4	68	62	B	–/–	–	–
New Caledonia	0.2	25	6	1.9	36	0.2	0.2	39	3.0	33/4	67	58	B	–/–	–	–
New Zealand	3.3	17	8	0.8	82	3.5	3.6	10.0	2.0	24/11	74	84	A	70/60	S	9,620
Pacific Islands[d]	0.2	36	5	3.1	22	0.2	0.3	29	5.0	47/4	71	29	C	5/–	–	–
Papua-New Guinea	4.0	39	12	2.7	26	5.1	7.9	59	5.7	41/2	54	13	B	5/–	H	770
Solomon Islands	0.3	41	5	3.5	20	0.5	0.8	40	6.3	47/3	61	9	B	–/23	H	430
Vanuatu	0.2	37	5	3.2	22	0.2	0.3	36	5.5	45/3	69	18	B	13/–	S	820
Western Samoa	0.2	34	7	2.8	25	0.2	0.3	48	4.6	40/4	66	21	B	–/19	H	580

[d]Comprising the Federated States of Micronesia, Palau, and the Marshal and N. Mariana Islands.

See notes page for additional definitions and sources.

World Population Data Sheet Definitions

Mid-1990 Population. Estimates are based on recent census or official national data or on UN, U.S. Bureau of the Census or World Bank projections. The effects of refugee movements and population shifts due to contemporary political events have been taken into account to the extent possible.

Birth and Death Rate. These rates are often referred to as "crude rates" since they do not take a population's age structure into account. Thus, crude death rates in more developed countries (MDCs) are often higher than those in less developed countries (LDCs) because the MDCs have a larger proportion of older persons.

Rate of Natural Increase (RNI). Birth rate minus the death rate, implying the annual rate of population growth without accounting for immigration or emigration.

Population "Doubling Time." The number of years in which a population would double assuming a *constant* rate of natural increase. This column is included to provide an indication of potential growth associated with a particular RNI. It is not intended to forecast the doubling of any population; for a more realistic expectation of future growth or decline, see the columns on projected population in 2000 and 2020.

Population in 2000 and 2020. Projected populations based on reasonable assumptions about the future course of fertility, mortality and migration. Data are based on official country projections or on series issued by the UN, the U.S. Bureau of the Census or the World Bank.

Infant Mortality Rate. The annual number of deaths to infants under age 1 year per 1,000 live births. Rates shown with one decimal place are those generally considered to be completely registered. Some differences in definition of an infant death affect comparability of rates from country to country and some "complete" rates are for year of registration rather than year of occurrence.

Total Fertility Rate (TFR). The average number of children a woman will bear in her lifetime assuming that current age-specific birth rates will remain constant throughout her childbearing years (usually considered to be ages 15-49).

Population Under Age 15/Age 65+. The percent of the total population in those two age groups, which are often considered the "dependent ages."

Life Expectancy at Birth. The average number of years a newborn infant can be expected to live under *current* mortality levels.

Urban Population. Percent of total population in areas termed urban by that country.

Data Availability. Provides a general indication of the data from countries from which data or estimates can be derived. An "A" indicates a country with complete vital statistics and a published national census within 10 years or a continuous population register; countries rated "B" have one of those two sources plus a census more than 10 years old or a usable national survey or sample registration system within 10 years or both; "C" indicates that at least a census, a survey, or sample registration system more than 10 years old is available; "D" indicates that little or no reliable data are available and that estimates are based on fragmentary data and models. There can be considerable variation in the quality of data available even within the same category.

Contraceptive Use. The percent of women of reproductive age currently married or in union using contraception. "Modern" methods include the pill, the IUD, sterilization, and other chemical and barrier methods.

Government Perception of Fertility Level. This indicator gives the officially stated position of country governments as reported to the UN or obtained by PRB through other sources. The UN source used is *Trends in Population Policy,* United Nations, New York, 1989.

Per Capita GNP. The gross national product (GNP) data are from the *World Bank Atlas 1989.* The GNP includes the value of all domestic and foreign output. Figures in italics refer to 1987.

World Population Data Sheet Notes
World Environment Data Sheet Notes and Definitions

Population Data Sheet

The *Data Sheet* lists all geopolitical entities with populations of 150,000 or more and all members of the United Nations, regardless of population size. Geopolitical entities are defined as sovereign states and territories or commonwealths whose populations are normally shown separately in U.N. publications. Some of these areas are currently the subject of dispute or are of unresolved status. More developed regions, following the U.N. classification, comprise all of Europe and North America, plus Australia, Japan, New Zealand and the USSR. All other regions and countries are classified as less developed.

World and regional totals: Regional population totals are independently rounded and include small countries or areas not shown. Regional and world rates and percentages are weighted averages and are shown when data are available for at least two-thirds of the region's population.

World Population Data Sheets of different years should not be used as a time series. Fluctuations in values from year to year often reflect revisions based upon new data or estimates rather than actual changes in levels. Additional information on likely trends and consistent time series can be obtained from PRB and are available in U.N., World Bank, and U.S. Census Bureau publications.

Sources

Statistical bulletins and demographic yearbooks of the individual countries; the U.N. *Demographic Yearbook, 1988* and *Population and Vital Statistics Report* of the U.N. Statistical Office; *World Population Prospects as Assessed in 1988* of the U.N. Population Division; the data files of the Center for International Research, U.S. Bureau of the Census; data from the publications of the Council of Europe and the European Community; and long-term projections of the World Bank. Other sources include recent data from demographic surveys, direct communication with demographers and statistical bureaus in the U.S. and abroad and special studies. Specific data sources may be obtained by contacting the authors.

For countries with complete registration of births and deaths (indicated by an infant mortality rate shown to a decimal place), rates are those most recently available. For developed countries, nearly all birth, death, infant mortality and total fertility rates refer to 1988. For less developed countries, those rates generally refer to the latter half of the 1980s. Other measures, unless otherwise indicated, are for the year most recently available in the sources cited above.

Environment Data Sheet

Mid-1990 Population. Estimates are based on a recent census or official national data or U.N., U.S. Bureau of the Census or World Bank projections.

Per Capita Calorie Supply. Daily calorie requirement refers to the calories needed to sustain a person at normal levels of activity and health, taking into account age and sex distributions, average body weights and environmental temperatures. Estimates from the U.N. Food and Agriculture Organization.

Years to Halve Forest Cover. The number of years in which half of the forested area would be lost assuming that the current rate of deforestation were to continue unchanged. Data from World Resources Institute.

Commercial Energy Consumption. Includes energy from solids, liquids, gases and primary electricity. Data from the World Resources Institute.

Electric Energy from Fossil Fuels. Data from the World Resources Institute.

Access to Safe Water and Sanitation Services. Proportion of persons with reasonable access to safe drinking water, which includes treated surface water and untreated, but uncontaminated, water from protected springs, boreholes and wells. Sanitation services are defined as those served by connections to public sewers or household disposal systems. Estimates from the U.N. Environment Programme and the World Health Organization.

Gross Domestic Product (GDP) from Sources Other than Agriculture. The GDP measures the total output of goods and services for final use by residents. This figure shows only the total output of goods and services from industry, manufacturing and services. The proportion of the GDP derived from sources other than agriculture is an indicator of a country's level of development. Data from the World Bank.

Motor Vehicles per 1,000 Population. Data from the U.N. Environment Programme *Environmental Data Report 1989/90* and from the Europa Yearbook series.

Countries, Areas and Densities

Country	Area (sq. miles)	Pop./ sq. mile
Afghanistan	250,000	63
Albania	11,100	295
Algeria	919,590	28
Angola	481,350	18
Antigua and Barbuda	170	377
Argentina	1,068,300	30
Australia	2,967,900	6
Austria	32,370	235
Bahamas	5,380	46
Bahrain	240	2,172
Bangladesh	55,600	2,064
Barbados	170	1,548
Belgium	11,750	842
Belize	8,860	25
Benin	43,480	109
Bhutan	18,150	86
Bolivia	424,160	17
Botswana	231,800	5
Brazil	3,286,470	46
Brunei	2,230	115
Bulgaria	42,820	209
Burkina Faso	105,870	86
Burundi	10,750	525
Cambodia	69,900	100
Cameroon	183,570	60
Canada	3,851,790	7
Cape Verde	1,560	244
Central African Republic	240,530	12
Chad	495,750	10
Chile	292,260	45
China	3,705,390	302
Colombia	439,730	72
Comoros	690	663
Congo	132,050	17
Costa Rica	19,580	155
Côte d'Ivoire	124,500	101
Cuba	44,220	240
Cyprus	3,570	197
Czechoslovakia	49,370	318
Denmark	16,630	309
Djibouti	8,490	48
Dominica	290	294
Dominican Republic	18,810	381
Ecuador	109,480	98
Egypt	386,660	141
El Salvador	8,260	643
Equatorial Guinea	10,830	34
Ethiopia	471,780	110
Fiji	7,050	108
Finland	130,130	38
France	211,210	267
French Polynesia	1,540	109
Gabon	103,350	11
Gambia	4,360	197
Germany, East	41,830	390
Germany, West	95,980	659
Ghana	92,100	163
Greece	50,940	197
Grenada	130	641
Guadeloupe	690	498
Guatemala	42,040	219
Guinea	94,930	77
Guinea-Bissau	13,950	71
Guyana	83,000	9
Haiti	10,710	607
Honduras	43,280	119
Hong Kong	400	14,534
Hungary	35,920	294
Iceland	39,770	7
India	1,269,340	672
Indonesia	735,360	258
Iran	636,290	87
Iraq	167,920	112
Ireland	27,140	130
Israel	8,020	572
Italy	116,310	496
Jamaica	4,240	575
Japan	143,750	860
Jordan	37,740	109
Kenya	224,960	110
Korea, North	46,540	458
Korea, South	38,020	1,125
Kuwait	6,880	311
Laos	91,430	44
Lebanon	4,020	832
Lesotho	11,720	151
Liberia	43,000	61
Libya	679,360	6
Luxembourg	990	374
Macao	10	58,793
Madagascar	226,660	53
Malawi	45,750	200
Malaysia	127,320	140
Maldives	120	1,882
Mali	478,760	17
Malta	120	2,849
Martinique	420	801
Mauritania	397,950	5
Mauritius	790	1,354
Mexico	761,600	116
Mongolia	604,250	4
Morocco	172,410	149
Mozambique	309,490	51
Myanmar (Burma)	261,220	158
Namibia	318,260	5
Nepal	54,360	352
Netherlands	14,410	1,033
Netherlands Antilles	300	610
New Caledonia	7,360	21
New Zealand	103,740	32
Nicaragua	50,190	77
Niger	489,190	16
Nigeria	356,670	333
Norway	125,180	34
Oman	82,030	18
Pacific Islands	690	269
Pakistan	310,400	369
Panama	29,760	81
Papua-New Guinea	178,260	23
Paraguay	157,050	27
Peru	496,220	44
Philippines	115,830	571
Poland	120,730	313
Portugal	35,550	291
Puerto Rico	3,440	958
Qatar	4,250	116
Reunion	970	614
Romania	91,700	254
Rwanda	10,170	715
St. Kitts-Nevis	140	288
Saint Lucia	240	639
St. Vincent & the Grenadines	150	753
Sao Tome and Principe	370	337
Saudi Arabia	830,000	18
Senegal	75,750	97
Seychelles	110	629
Sierra Leone	27,700	150
Singapore	220	12,177
Solomon Islands	10,980	30
Somalia	246,200	34
South Africa	471,440	84
Spain	194,900	202
Sri Lanka	25,330	679
Sudan	967,490	26
Suriname	63,040	6
Swaziland	6,700	116
Sweden	173,730	49
Switzerland	15,940	420
Syria	71,500	176
Taiwan	12,460	1,623
Tanzania	364,900	71
Thailand	198,460	281
Togo	21,930	168
Trinidad and Tobago	1,980	679
Tunisia	63,170	129
Turkey	301,380	188
Uganda	91,140	197
United Arab Emirates	32,280	49
United Kingdom	94,530	607
United States	3,615,100	70
Uruguay	68,040	45
USSR	8,649,500	34
Vanuatu	5,700	29
Venezuela	352,140	56
Viet Nam	127,240	552
Western Sahara	103,000	2
Western Samoa	1,100	155
Yemen, North	75,290	95
Yemen, South	128,560	20
Yugoslavia	98,760	241
Zaire	905,560	40
Zambia	290,580	28
Zimbabwe	150,800	64

Notes: 1 square mile = 2.59 square kilometers.

1990 World Environment Data Sheet

	Population Estimate mid-1990 (millions)	Population Change 1955-1990/ 1990-2025 (percent)	Per Capita Calorie Supply as Percent of Requirements	Years to Halve Forest Cover	Per Capita Commercial Energy Consumption, 1987 (UN standard barrels of oil)	Electric Energy from Fossil Fuel, 1987 (percent)	Access to Safe Water/ Sanitation Services, 1985 (percent)	GDP from Sources Other than Agriculture, 1988 (percent)	Motor Vehicles per 1,000 Population 1970s/1980s
WORLD	**5,321**	**92/60**	–	–	**9.2**	**64**	**54/33**	–	–/–
AFRICA	**661**	**159/144**	–	**139**	**2.0**	**81**	**37/28**	–	–/–
Algeria	26	161/99	115	30	6.9	98	68/57	87	32/42
Angola	9	126/147	82	347	0.5	26	33/19	–	–/10
Botswana	1	197/162	93	693	–	–	53/–	97	22/36
Burkina Faso	9	120/152	85	41	0.2	100	67/9	61	4/–
Cameroon	11	126/133	88	173	1.3	3	32/43	74	–/11
Cape Verde	0.4	120/134	100	–	–	100	52/10	–	–/12
Chad	5	100/133	59	116	0.2	100	–/–	53	4/–
Côte d'Ivoire	13	291/216	112	13	1.0	41	–/–	64	17/–
Egypt	55	135/74	126	–	3.3	82	–/–	79	–/23
Ethiopia	52	116/140	84	231	0.2	20	16/–	57	1/1
Gabon	1	145/150	102	693	5.6	23	–/–	89	–/22
Gambia	1	174/116	95	29	0.7	100	59/–	–	–/8
Ghana	15	161/147	66	87	0.7	2	56/30	50	1/6
Guinea	7	101/128	84	87	0.3	67	18/–	70	41/36
Guinea-Bissau	1	90/119	82	26	0.3	100	21/21	–	8/–
Kenya	25	250/209	83	41	0.5	14	–/–	69	12/–
Lesotho	2	123/141	104	–	–	–	36/15	80	8/–
Madagascar	12	154/175	112	58	0.2	46	31/–	59	–/4
Malawi	9	166/171	95	20	0.2	2	56/–	62	5/5
Mali	8	123/158	68	139	0.2	21	16/19	51	3/–
Mauritania	2	125/145	92	29	3.8	79	–/–	62	–/10
Morocco	26	148/76	105	173	1.6	91	59/–	83	28/36
Mozambique	16	132/119	71	87	0.2	88	15/20	38	13/8
Niger	8	135/166	97	27	0.3	100	47/–	64	5/–
Nigeria	119	205/167	86	26	0.8	78	38/–	65	3/–
Rwanda	7	202/150	98	30	0.2	2	50/56	62	1/–
Senegal	7	168/122	82	139	0.7	100	53/–	78	19/15
Sierra Leone	4	99/132	91	231	0.3	100	24/24	54	9/–
South Africa	40	129/79	118	–	13.6	96	–/–	94	128/154
Sudan	25	148/137	90	347	0.3	51	–/–	67	8/9
Tanzania	26	210/210	98	231	0.2	30	53/–	34	3/–
Tunisia	8	112/63	121	41	3.1	98	70/55	86	32/57
Uganda	18	232/199	101	87	0.2	2	20/30	27	2/3
Zaire	37	156/176	96	347	0.3	3	32/–	69	7/–
Zambia	8	207/201	83	231	1.1	z	58/55	86	23/21
Zimbabwe	10	198/133	82	173	3.4	67	–/–	89	–/39
ASIA	**3,116**	**106/57**	–	–	**3.4**	**69**	–/–	–	–/–
Afghanistan	16	70/148	95	–	0.7	39	17/–	–	4/–
Bangladesh	115	154/103	84	77	0.3	91	46/5	54	–/1
Bhutan	2	90/103	90	693	0.2	62	–/–	56	–/3
China	1,120	86/31	111	–	3.6	80	–/–	67	21/–
Cyprus	1	32/29	137	–	11.8	100	100/100	–	18/34
Hong Kong	6	135/19	117	–	–	–	–/–	99	41/53
India	853	116/69	96	231	1.3	71	56/9	68	2/–
Indonesia	189	109/46	110	139	1.3	78	38/37	76	–/13
Iran	56	232/116	128	139	6.2	83	–/–	–	54/71
Iraq	19	220/164	121	–	3.6	97	86/74	–	19/46
Israel	5	162/51	121	–	13.4	100	–/–	–	114/–
Japan	124	37/4	113	–	18.0	61	–/–	98	280/408
Korea, North	21	152/73	127	–	12.9	42	–/–	–	7/39
Korea, South	43	103/25	118	–	8.5	44	75/100	89	–/60

(–) data unavailable or inapplicable

Region or Country	Population Estimate mid-1990 (millions)	Population Change 1955-1990/ 1990-2025 (percent)	Per Capita Calorie Supply as Percent of Requirements	Years to Halve Forest Cover	Per Capita Commercial Energy Consumption, 1987 (UN standard barrels of oil)	Electric Energy from Fossil Fuel, 1987 (percent)	Access to Safe Water/ Sanitation Services, 1985 (percent)	GDP from Sources Other than Agriculture, 1988 (percent)	Motor Vehicles per 1,000 Population 1970s/1980s
Kuwait	2	950/108	–	–	44.0	100	–/–	99	290/–
Malaysia	18	148/61	111	58	6.2	72	84/75	–	58/111
Myanmar	41	113/74	116	231	0.3	51	27/24	–	–/–
Nepal	19	121/83	93	17	0.2	5	28/–	44	2/–
Pakistan	115	178/118	95	173	1.1	53	44/19	73	2/3
Philippines	66	161/78	104	69	1.3	59	52/67	78	–/16
Saudi Arabia	15	293/217	134	–	30.2	100	94/82	93	72/388
Sri Lanka	17	97/42	104	20	0.7	20	40/44	74	11/–
Syria	13	215/158	127	–	4.9	79	–/–	62	23/28
Thailand	56	145/45	105	29	2.3	86	64/52	83	16/28
Turkey	57	133/61	123	–	4.7	58	–/–	82	21/34
Viet Nam	70	110/76	99	116	0.5	62	45/–	–	–/–
Yemen	10	122/183	94	–	1.8	100	43/–	–	–/34
NORTH AMERICA	**278**	**52/21**	**–**	**–**	**45.9**	**85**	**–/–**	**–**	**–/–**
Canada	27	69/21	130	–	47.5	21	–/–	96	515/581
United States	251	50/21	137	–	45.8	73	–/–	98	649/728
LATIN AMERICA	**447**	**136/70**	**–**	**–**	**–**	**39**	**–/–**	**–**	**–/–**
Argentina	32	71/41	119	20	9.2	46	56/69	88	145/172
Bolivia	7	138/150	82	347	1.5	26	43/21	76	–/38
Brazil	150	140/63	106	139	3.6	8	77/63	91	67/–
Chile	13	94/50	105	99	4.6	22	87/84	–	45/75
Colombia	32	138/63	110	41	3.9	28	–/–	81	25/43
Cuba	11	61/16	126	693	6.9	100	–/–	–	–/37
Dominican Republic	7	162/60	105	116	2.0	82	62/23	77	23/27
Ecuador	11	183/112	89	30	2.9	19	57/65	85	–/30
Guatemala	9	168/136	95	35	0.8	62	37/24	–	–/34
Haiti	7	94/77	83	18	0.2	29	38/21	69	7/10
Mexico	89	173/69	126	53	8.2	78	83/58	91	–/97
Nicaragua	4	203/138	102	26	1.5	47	48/27	81	25/23
Paraguay	4	176/115	122	–	1.3	z	28/85	71	–/31
Peru	22	158/84	85	173	2.8	22	55/49	87	–/31
Puerto Rico	3	65/40	–	–	–	–	–/–	–	–/443
Uruguay	3	32/24	99	–	3.1	7	85/59	89	–/112
Venezuela	20	221/93	99	99	14.4	56	89/50	94	–/228
EUROPE	**501**	**22**	**3/–**	**–**	**21.2**	**54**	**–/–**	**–**	**–/–**
Albania	3	134/54	–	–	6.2	13	–/–	–	–/–
Czechoslovakia	16	20/10	145	–	30.2	68	–/–	–	134/–
France	56	29/8	138	–	17.8	10	–/–	96	361/468
Germany	80	10/–9	132	–	29.2	69	–/–	–	355/471
Italy	58	18/–4	140	–	17.2	78	–/–	96	312/449
Netherlands	15	37/2	129	–	34.8	95	–/–	95	304/380
Poland	38	41/17	127	–	23.0	97	–/–	–	61/137
Spain	39	35/8	132	–	10.1	48	–/–	94	194/311
Sweden	9	15/–2	117	–	24.0	5	–/–	97	368/431
Switzerland	7	31/–6	129	–	18.1	2	–/–	–	331/454
United Kingdom	57	11/1	128	–	24.5	80	–/–	98	293/373
Yugoslavia	24	36/10	141	–	11.6	58	–/–	–	88/137
USSR	**291**	**47/22**	**132**	**–**	**31.7**	**76**	**–/–**	**–**	**–/–**
OCEANIA	**27**	**87/47**	**–**	**–**	**24.0**	**78**	**–/–**	**–**	**–/–**
Australia	17	81/35	115	–	32.8	89	–/–	96	470/575
New Zealand	3	58/20	132	–	18.5	23	–/–	90	471/608

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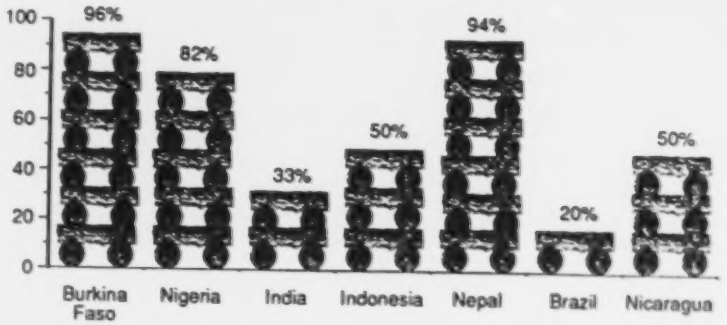
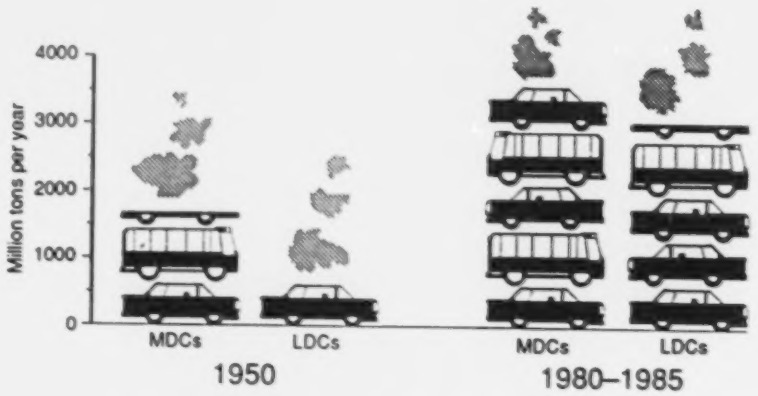
Share of Energy Use Provided by Wood Selected Countries: 1980s

Many people in less developed countries (LDCs) depend on wood as their primary energy source. Over two-thirds of all people in LDCs rely on wood for cooking and heating. Those living in rural areas, particulary in Africa, may depend on wood for as much as 90 percent of their energy needs.



Source: Worldwatch Institute, *State of the World 1988*.



MDCs = More developed countries
LDCs = Less developed countries

Source: World Resources Institute.

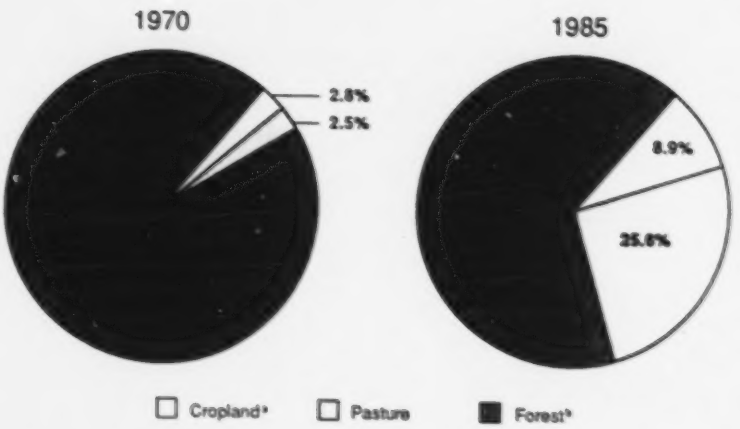
Carbon Emissions in More Developed and Less Developed Countries: 1950 and 1980-1985 (million tons per year)

Carbon is produced from the burning of fossil fuels and the burning of forests. Each ton of carbon emitted into the atmosphere results in 3.2 tons of carbon dioxide. Carbon dioxide is responsible for about half of global warming.

As world population grows, the amount of carbon released into the air increases. Because most of future population growth is projected to occur in less developed countries (LDCs), they will produce more of the carbon dioxide emissions in the future. By 2020, LDCs are projected to account for half of all carbon dioxide emissions.

Agricultural Land Use in Rondônia, Brazil: 1970-1985

As world population grows and the demand for food and other consumer products rises, the amount of land converted for human use increases. More land in developing countries is being converted to cropland and pasture each year. Rondônia, a state in the Brazilian Amazon, is an example of an area where millions of acres of virgin forest are being cleared to provide cropland and grazing land.



a—includes fallow land
b—includes natural pastures

Source: The World Bank, *Government Policies and Deforestation in Brazil's Amazon Region*, 1989.

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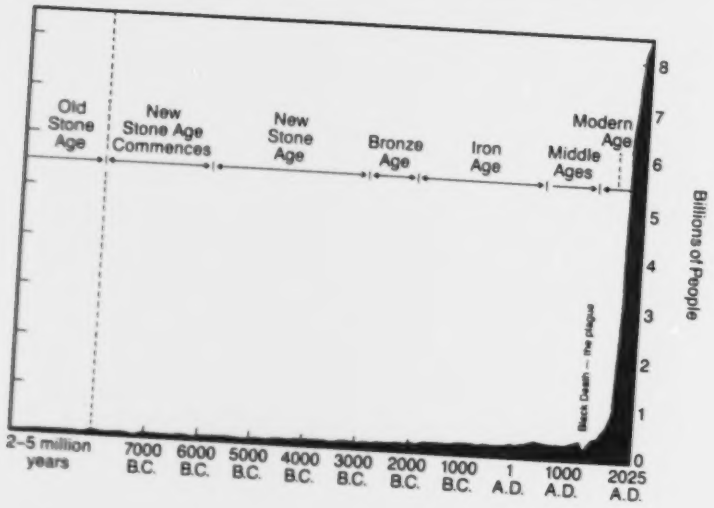
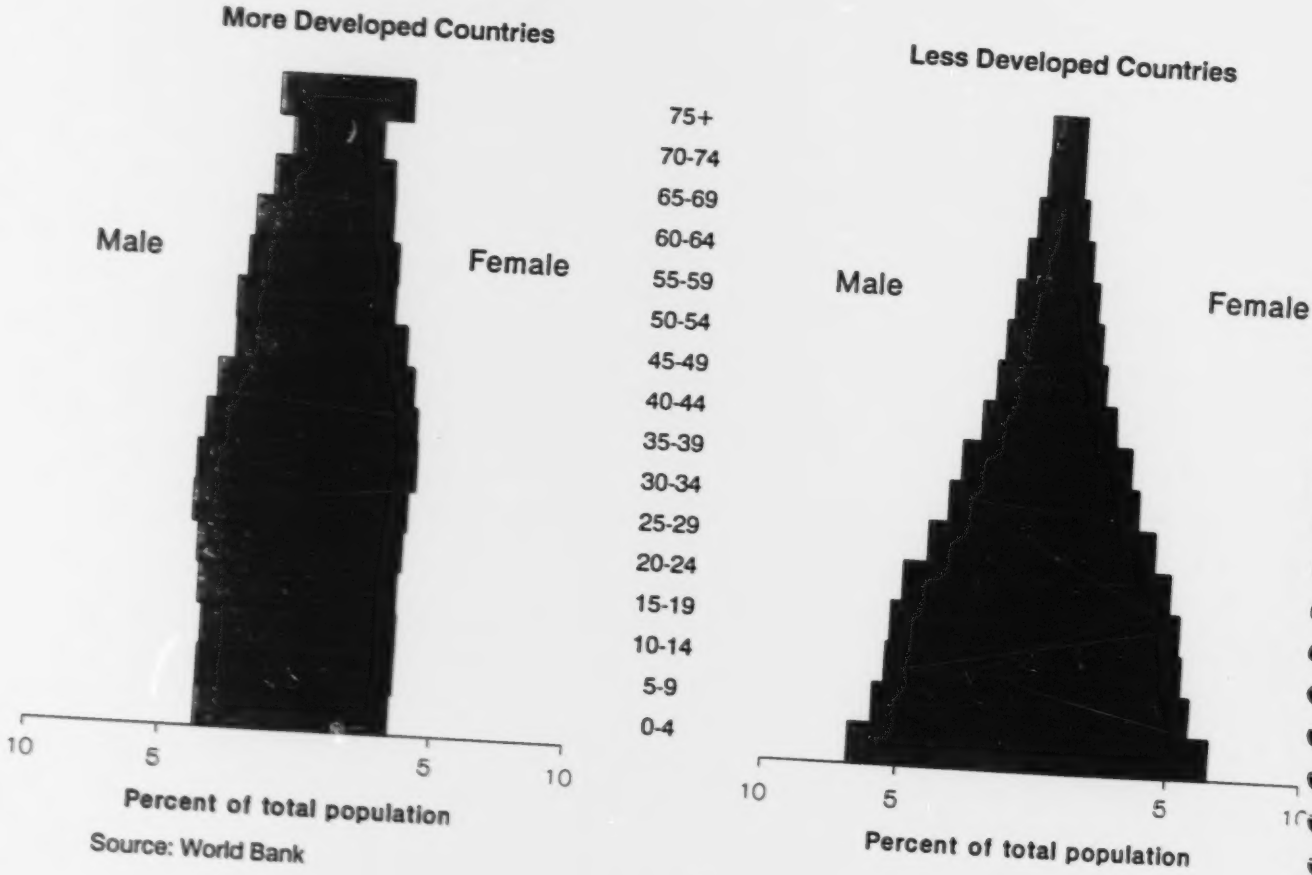
More charts and graphs

World Population Growth Through History



Age and Sex Distribution, 1990



Source: World Bank

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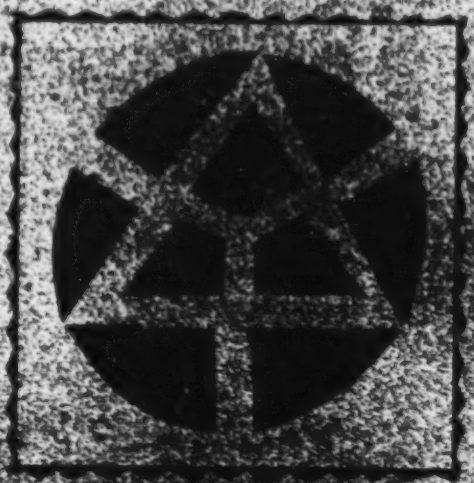
CONNECTIONS



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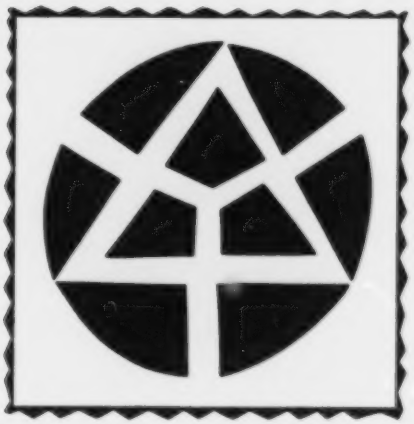
CONNECTIONS

Linking Population and the Environment



Teacher's Guide

Edited by Kimberly A. Crews and Patricia Cancellier
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1991

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Ordering Information: Additional copies of the *Student Resource Book* are $8.00 each. Complete teacher's kit $13.00 (includes *Teacher's Guide, Student Resource Book, World Population Data Sheet* and *World Environment Data Sheet*). Data Sheets are $3.00 each. Orders under $50.00 must be prepaid with $1.00 or 4 percent (whichever is greater) for shipping and handling. Send orders to Circulation Department, Population Reference Bureau (address above).

This Teacher's Guide is part of the CONNECTIONS teaching kit developed to help students understand the links between population and the environment in the context of sustainable development. The ultimate goal of the project is to develop students' concern for the environment, a sense of responsibility for its protection, awareness of the links between population and the environment and the realization that they live in a global village.

The CONNECTIONS project was made possible by support from the Geraldine R. Dodge Foundation, the George Gund Foundation, the David and Lucile Packard Foundation, the U.S. Agency for International Development and the John Edward Fowler Memorial Foundation.

During the summer of 1990 five teachers active in their state Geographic Alliances joined PRB staff to participate in the development of the lessons in this book. They spent a good deal of time and energy previewing materials, developing lessons, reviewing materials and testing the lessons in their classrooms. We sincerely appreciate the help of these dedicated educators.

Charlie Fitzpatrick
St. Paul Academy and Summit School
St. Paul, MN

Kay Sandmeier
National Geographic Society
Geographic Education Program
Washington, D.C.

Martha Sharma
National Cathedral School
Washington, D.C.

Fred Willman
Jefferson Jr. High School
Napierville, IL

Milbrey Zelley
Metuchen High School
Metuchen, NJ

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We also appreciate the help of the following educators, who field-tested the lessons in this book: Janet Howard, Readington School, Readington, NJ; Patricia Watson, Nicholas Orem Middle School, Hyattsville, MD; Terry Robidoux, Michigan Geographic Alliance; Karen Todorov, Michigan Geographic Alliance; Cindy Miles, West Intermediate School, Mt. Pleasant, MI; Fred Walk, Illinois Geographic Alliance.

Special thanks to the CONNECTIONS Advisory Committee: Barbara Graves, Charles County School District, MD; Martha Sharma, National Cathedral School, Washington, D.C.; Barbara Winston, Northeastern Illinois University.

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Dear Educator:

The CONNECTIONS project is designed to help teachers and students better understand the links between population, environment and sustainable development. This project was inspired by the *Global Edition* project, an effort by the Population Reference Bureau to produce and disseminate materials on the links between population and environmental issues from a Third World perspective. *Global Edition* assists journalists in developing countries in writing articles to help educate their readers about population/environment connections. Most of the articles in the *Student Resource Book* appeared, as part of the *Global Edition* project, in newspapers and magazines in the Third World. While some editing of the articles occurred, an effort was made to leave them in their original state so that students would be able to experience a non-U.S. view of these global problems. (Note: There are, as a result, inconsistencies in the spelling of some words. Some of the articles use international or British English spellings while others use American English. Also, students may be unaccustomed to the writing styles of some of the authors.)

The readings in the *Student Resource Guide* are divided into geographic units: the world, Africa, Asia and Latin America. Within each unit is an article on the region, and when available, articles on specific countries in that region. Terms that appear in the glossary, located at the back of the *Student Resource Guide*, are highlighted in color in the text. Units of measure that may be unfamiliar to your students are defined in the margin. Page-size versions of the *World Population Data Sheet* and *World Environment Data Sheet* can be found at the end of the book.

This *Teacher's Guide* contains 27 lessons that complement the articles, expand on selected concepts and issues and help students make the connections between population growth, environmental concerns and sustainable development. Some of the lessons are specifically tied to a particular region or country. Others are more generic and can be used when studying any of the regions and countries in the package. The lessons can be used alone or as a unit. Accompanying worksheets can be found at the end of the lessons. A learning matrix, showing the countries, topics and skills that are covered in each lesson and reading, can be found on pages 6–9. A resource list containing additional books, articles and audiovisual aids can be found at the beginning of each section (see Table of Contents).

The lessons in the *Teacher's Guide* were developed by geography, social studies and economics teachers in the summer of 1990. They have been field tested in junior high and high school classrooms in several states. Many of the lessons were also evaluated by teachers participating in workshops presented by the Population Reference Bureau. Without the direct participation of these classroom teachers, the development of these materials would not have been possible.

We welcome your comments and suggestions on the CONNECTIONS package. An evaluation form is enclosed. Recommended changes will be considered for incorporation when the package is revised and reprinted.

Kimberly Crews
Patricia Cancellier

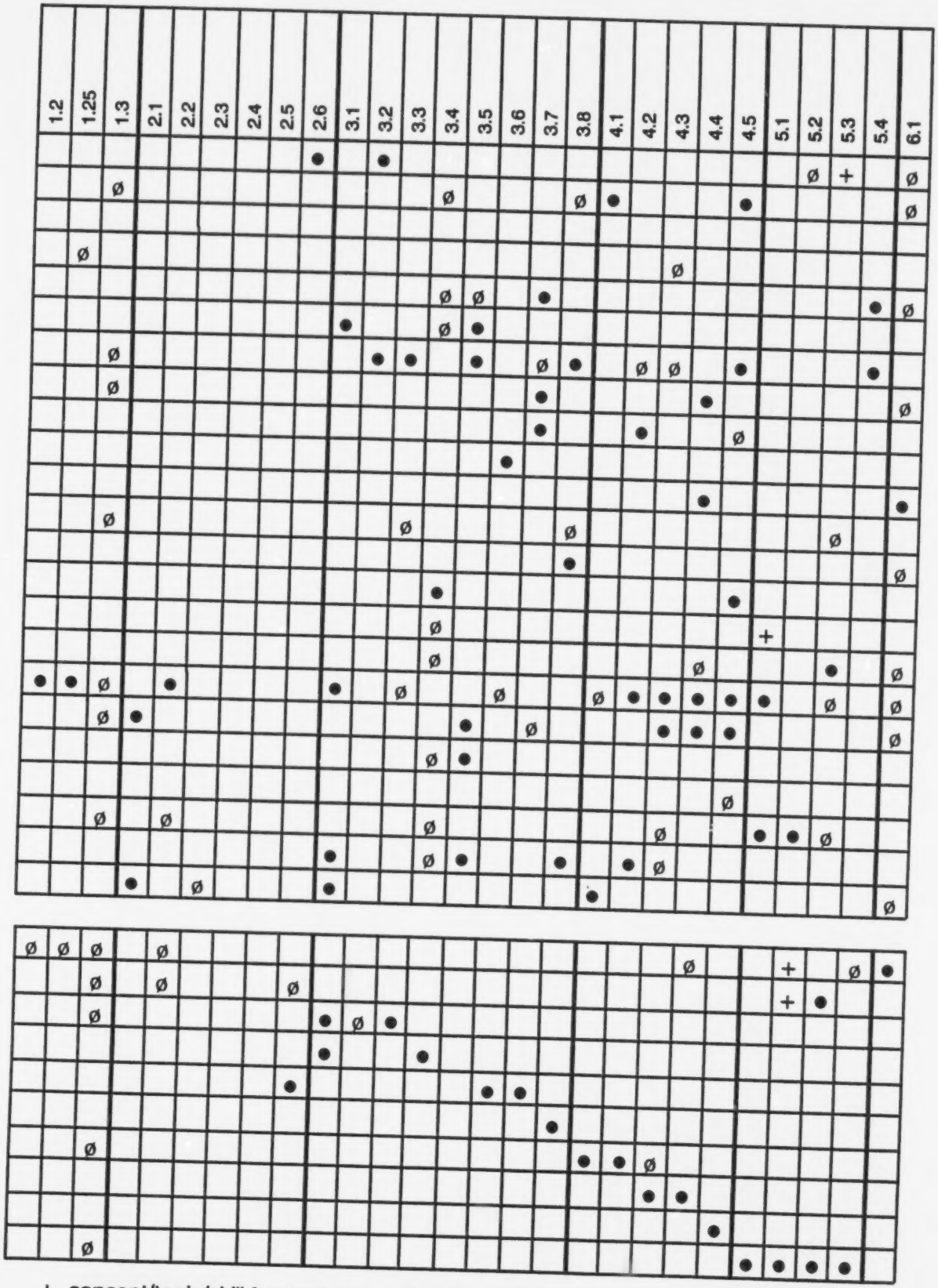
Kimberly Crews and Patricia Cancellier
Population Education Program
Population Reference Bureau

Matrix of Concepts, Topics and Skills

Readings and Lesson No.

Geographic/Economic/ Development Topics	The Challenge	Africa	Poverty	Sahel	Kenya Pt. 1	Kenya Pt. 2	Egypt	Asia	Bangladesh	Deltas	Philippines	Latin America	Wrap-Up	1.1
Age structure		ø						ø						
Agriculture/Food	●	●		●		●	●	●	●		ø	ø	ø	ø
Aid					●		ø	ø	ø					
Carrying capacity	ø							●						ø
Deforestation	ø	●		ø		●		●	●		●	●		ø
Desertification	ø	●		●			ø	●					ø	ø
Economic concepts				●		ø					ø	●		
Energy/Fuel	ø	ø				●		ø				ø	●	
Erosion	ø					●		ø				ø		
Family planning		ø			●		ø		ø			ø		
Global warming	ø								ø	●		ø	●	
Health/Sanitation	ø						ø					●		
Irrigation/Dams	ø						●	●						ø
Land degradation	ø	●	ø			ø		●	●		●	●		ø
Migration/Movement	ø	ø		●					●		●	ø		
Pollution	ø								ø			●	●	
Population growth	●	●	ø	●	●		●	●	●		●	●		ø
Resources	●	ø	ø			ø								ø
Survival	ø		●			ø			●					
Sustainable development	●	ø	●	ø			ø	●			●	ø	●	ø
Urbanization		ø										●		ø
Water supply/Drought		●		●		ø	●	●	●			ø		ø
Weather/Climate		ø		ø				ø	ø	ø			●	
Regions/Countries														
World	●									●			●	
Developed world examples	ø												●	
Africa	ø	●	ø	ø	ø									
The Sahel				●										ø
Kenya					●	●								
Egypt							●							
Asia	ø								●	●				
Bangladesh										●	●			
Philippines												●		
Latin America	ø												●	

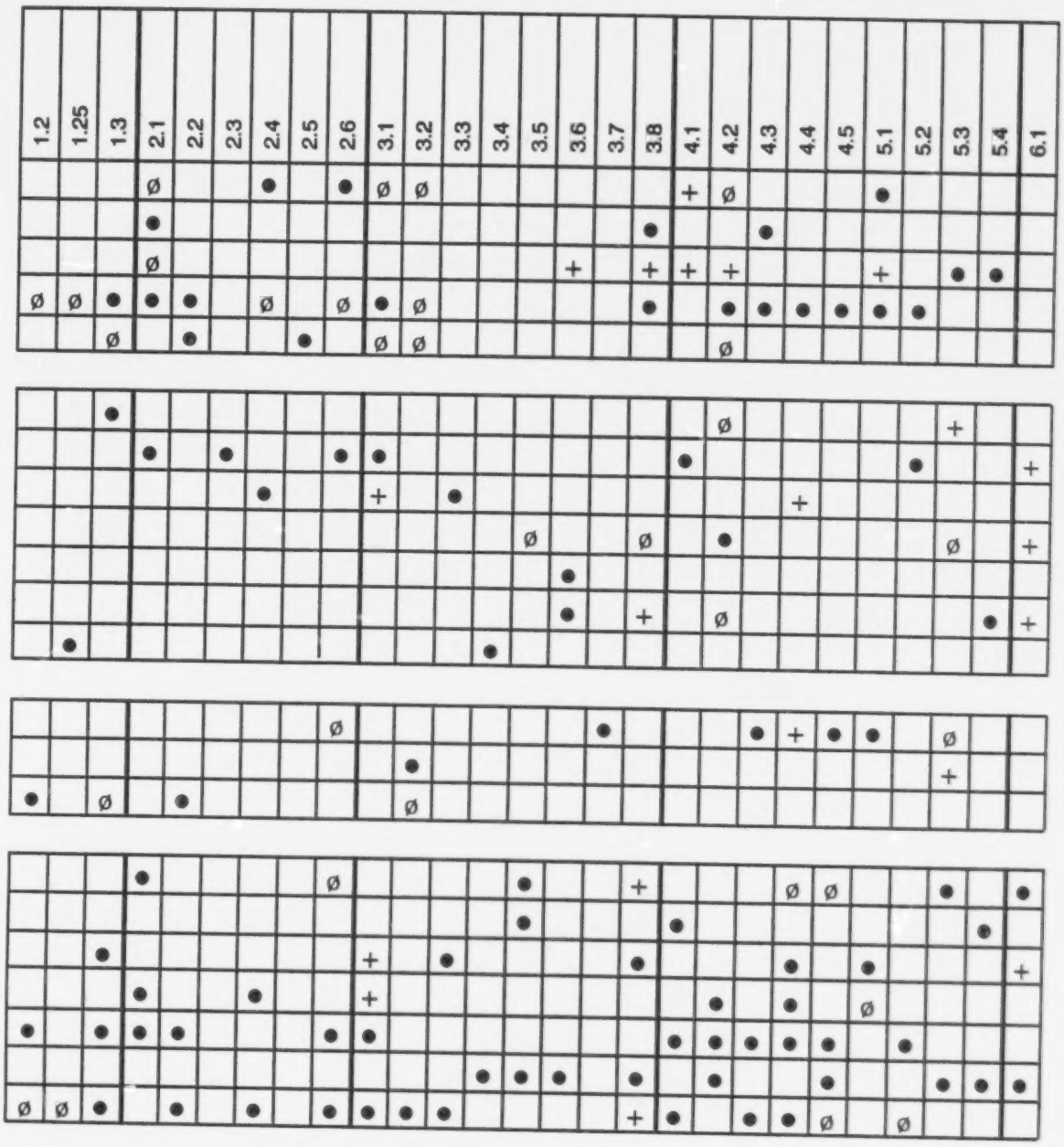
Key ● concept/topic/skill focused on ø concept/topic/skill mentioned or introduced



+ concept/topic/skill focused on in extension activity

Skills	Readings and Lesson No.													
	The Challenge	Africa	Poverty	Sahel	Kenya Pt. 1	Kenya Pt. 2	Egypt	Asia	Bangladesh	Deltas	Philippines	Latin America	Wrap-Up	1.1
Acquiring Information Skills														
Identifying locations														
Observing photographic evidence														
Research														
Table, chart and map reading														
Vocabulary development														•
Presenting Information Skills														
Creative and essay writing														
Preparing graphs and tables														
Preparing thematic maps														
Oral Communication														
Persuasive speaking														
Role Playing														
Simulation														
Processing Information Skills														
Classification														•
Computing rates														
Conceptualizing rates and measures														
Analyzing Information														
Brainstorming/speculation														
Critical thinking														
Inductive reasoning/hypothesizing														
Interpreting maps														
Interpreting tables and graphs														
Problem solving/decision making														
Using Data Sheets														

Key • concept/topic/skill focused on ø concept/topic/skill mentioned or introduced



+ concept/topic/skill focused on in extension activity

Section I World Overview

The lessons in this section are designed to accompany the reading, "The Challenge of Our Times." This reading is an overview of world population trends and the state of the environment. In this piece the reader is introduced to **Child 5-Billion**, a mythical baby whose birth would have celebrated the human population reaching the 5 billion mark. The author uses **Child 5-Billion** as the centerpiece of his article by hypothesizing about what **Child 5-Billion's** life will be like given current conditions and trends.

The lessons in this section are designed to help students become comfortable with the vocabulary and demographic concepts that are used in all of the CONNECTIONS readings and lessons. They also introduce the student to the *World Population Data Sheet* and *World Environment Data Sheet*, which are used in many lessons in this guide.

The first lesson in this unit, "Connecting Words, Connecting Worlds," is a vocabulary development activity. Lesson 1.2 introduces students to the concept of population growth, showing the relationship between births and deaths; activities in this lesson also help the students become comfortable with the large numbers (millions and billions) that are used to describe population size and change. Lesson 1.3 helps students further increase the ease with which they use data, as they develop a description of a hypothetical **Child 5-Billion**.

Resources

Books

Atlas of Environmental Issues, by Nick Middleton. New York: Facts On File, 1989. 63 pp.

Atlas of World Population History, by Colin McEvedy & Richard Jones. London: Lane, 1978. 368 pp.

GAIA: An Atlas of Planet Management, edited by Norman Meyers. New York: Anchor Press, Doubleday, 1984. 272 pp.

One Earth, One Future (Our Changing Global Environment), by the National Academy of Sciences. Washington, D.C.: National Academy Press, 1990. 196 pp.

Our Common Future, by the World Commission on Environment and Development. Oxford: Oxford University Press, 1987. 400 pp.

Planet Earth, by David Lambert. New York: Facts On File, 1985. 65 pp.

Population Growth, by Eric McGraw. Florida: Rourke Enterprises, Inc., 1987. 46 pp.

State of the Ark, by Lee Durrell. New York: Doubleday, 1986. 224 pp.

Toward Sustainable Development, by The Panos Institute. London: Panos Publications Ltd., 1987.

World Resources 1990-91, by The World Resources Institute, The United Nations Environment Programme and The United Nations Development Programme. New York: Oxford University Press, 1990. 378 pp.

Articles

"Fighting to Save a Fragile World," *International Wildlife* (March-April 1990) (special issue).

"Growing, Growing, Gone," by P. R. Ehrlich and A. H. Ehrlich. *Sierra* Vol. 75 (March-April 1990). pp. 36-40.

"The Growing Human Population," by N. Keyfitz. *Scientific American* Vol. 261 (September 1989). pp. 188-26.

"Population, Plenty, and Poverty," *National Geographic* Vol. 174, No. 6 (December 1988). pp 914.

"Sustainable Development: Lessons From Success," by Walter V.C. Reid. *Environment* Vol. 31, No. 4 (May 1989). pp. 6+.

"Sustainable Agriculture in Developing Countries," *Environment* Vol. 30, No. 9 (November 1988) (special issue).

"Will We Mend Our Earth?" *National Geographic* Vol. 174, No. 6 (December 1988). pp. 766.

Audiovisuals

Earth: The Changing Environment. 1987, 28 minutes, Jr. High–Adult, VHS. Purchase for approx. $40 from PBS Video, 1320 Braddock Place, Alexandria, VA 22314–1698. (800) 424–7963. Available for rental from PRB.

An examination of the impact that modernization has had on the environment. Scenes from both industrialized and developing nations show the effects that both economic development and lack of economic development have on the environment and resources. The concluding message: development efforts and environmental protection must go hand–in–hand.

The Environmental Revolution (from the "Race to Save the Planet" series). 1990, 60 minutes, High School–Adult, VHS. Purchasing information from the Annenberg/CPB Project at (800) LEARNER, P.O. Box 1922, Santa Barbara, CA 93116–1922. Available for rental from PRB.

This is the opening program of the "Race to Save the Planet" series. It takes a look at the tenuous relationship between humans and their environment and attempts to understand the changes, through time, from coexistence to domination.

Population Patterns and Technology. 1988, 20 minutes, Jr. High–High School, VHS. Purchase for $150 (plus shipping) from the Agency for Instructional Technology, Box A, 1111 West 17th Street, Bloomington, IN 47404–3098. (800) 457–4509. Available for rental from PRB.

This video is part of the 12–program "You, Me, and Technology" series. It examines world population growth as a result of four technological revolutions: toolmaking, agricultural, industrial and informational. Emphasis is placed on the fact that rapid population growth has been a recent phenomenon caused by a drop in mortality as a result of worldwide improvements in health and hygiene.

Population Change and Economic Development. 1987, 25 minutes, High School–Adult, 3/4" and VHS. Available for rental from PRB.

This film makes very clear the connections between population change and economic development. The film opens with a graphic display of how the world population has grown historically and how it will grow in the future. It explains why most of the growth today is taking place in developing countries and why such rapid growth is a greater burden for these countries than it was for the developed nations during their period of growth. The film also discusses official population policies and their place in the realm of family planning; why family planning is necessary and the various factors that can contribute to the success of such programs.

What is the Limit? 1987, 23 minutes, High School–Adult, VHS. Available for $15 from the National Audubon Society, 801 Pennsylvania Ave., S.E., Suite 301, Washington, D.C. 20003.

A survey of the environmental problems triggered by modern methods of production, both in the industrial and agricultural sectors all over the world. The film also points to rapid population growth as a factor in the threat to man's prosperity. The following are discussed in the conclusion: 1) What is the responsibility of the developed countries to the poorer ones? and 2) What is the current U.S. policy on family planning?

World Population. 1990, 6 minutes, Elem.–Adult, VHS and 16mm. Available in VHS for $32.95 (includes postage) from Zero Population Growth, 1400 16th Street, N.W., Suite 320, Washington, D.C. 20036.

A revised version of the classic 1972 film presenting the best–ever graphic simulation of human population growth. In this video, dots are placed on a world map to represent millions of people added to the population from A.D. 1 to the present and projected to 2050. Historic references have been added to this edition to place population changes in context.

Lesson 1.1 Connecting Worlds, Connecting Words

Overview: The purpose of this lesson is to introduce students to the topics, concepts and basic vocabulary of the CONNECTIONS unit. Students will become familiar with vocabulary terms that will be encountered in all of the readings and lessons. **Note: If you do not intend to conduct Lesson 1.2 with your students, please assign the reading "The Challenge of Our Times" Part 1 for homework and follow up with the discussion mentioned in Procedure #2, Day 2 of 1.2.**

Region: World

Grade Level: 7–12

Learning Objectives:

Students will:
1. Classify demographic, environmental and development terms.
2. Interpret demographic, environmental and development terms.

Skills To Be Developed:

1. Classification
2. Vocabulary development

Vocabulary To Be Developed:

25 terms (see Lesson 1.1 Handout)

Time Needed: 1 day

Materials:

1. Copies of "Vocabulary" (Lesson 1.1 Handout)
2. Scissors (1 per 3–4 students)

Procedure:

1. Distribute copies of Lesson 1.1 Handout to students. Have students read over the vocabulary list and take a few minutes to examine the kinds of terms on the list. Clarify terms, as necessary.

2. Students cut up the list of terms so that they have 25 cards, each card having one word and one definition.

3. Have students work individually or in groups to classify the terms into three to five categories. They should be able to describe the rationale for their category headings. Some students may need assistance identifying reasonable headings. (Some suggestions: population, environment, location, people, development, agriculture, land measures, misc., etc.)

4. If students have worked individually, join them into groups of three or four and have them compare their classification strategies.

5. Compare the category headings for the whole class. Write some on the board. Ask students if they think some words could fit into more that one category. Are the categories related? Do any of the words in one category have a relationship to words in other categories? Choose the term "population growth rate." Ask students to speculate upon the relationship between the population growth rate and some of the other terms. How might a high population growth rate affect land degradation? What about the total population? How does the number of people affect the resources in the area?

6. Have students consider this relationship for homework. Also have them find out the population of the world.

Extensions & Variations:

1. Provide a chart with suggested categories for younger students. Do a follow–up activity of matching vocabulary with definitions ("Concentration" game).

2. Have students turn over their vocabulary cards, write in the term and draw an appropriate graphic for all or selected terms.

3. Play "Review Jeopardy" using selected categories.

4. To review the vocabulary terms, play "Lingo Bingo." (See Lesson 2.5 for instructions and cards.)

Biosphere The part of the earth, including the air and water, that can support life.	**Deforestation** The loss of trees, due to overcutting of forests. One consequence of deforestation is soil erosion, which results in the loss of protective soil cover and the water-holding capacity of the soil.	**Land Degradation** To lower the quality of the land making it less suitable for growing crops or raising livestock. Land degradation is caused by overcropping, overgrazing and using farming methods that make the land less fertile.	**Population Growth Rate** The rate at which a population is increasing (or decreasing) in a given time period, expressed as a percentage of the base population.	**Sedimentation (or Siltation)** Rock, gravel and other matter in a body of water (such as a river) that is deposited onto the floor of that body of water.
Birth rate The number of births per 1,000 population in a given year.	**Desertification** The process by which semi-arid grassland becomes desert, usually caused by overgrazing, deforestation, drought and changing climate.	**Less Developed Country (LDC) also called developing or Third World** A country that has low levels of average wealth, industrialization and modernization and often high levels of population growth and people employed in agriculture.	**Natural Increase** The surplus (or deficit) of births over deaths in a population in a given time period.	**Slash-and-Burn Agriculture** A type of farming where a patch of forest is cut and the area is burned. Ashes add nutrients to the soil. Crops are then planted between the stumps. When the soil loses its fertility the farmer moves to a new patch of land leaving the old one to return to its original state.
Carrying Capacity The greatest number of living species that can be supported in an area given its environmental condition.	**Ecosystem** A community of plants and animals interacting with one another and the environment.	**Life Expectancy** The average number of years a person can expect to live at the time of birth.	**Refugee** A person who leaves his native country because he fears for his survival.	**Sustainable Development** Practices (in agriculture, economic development, etc.) that lead to progress and meet the needs and desires of the current generation without depriving the ability of future generations to meet their needs.
Catchment Basin The area drained by a river or river system. The catchment is where rain water initially falls. This water then drains to a river.	**Finite Resources** Resources that are limited in quantity. When they are all used they can not be replaced.	**More Developed Country (MDC)also called developed** Countries with higher levels of per capita income, industrialization and modernization. They usually have lower levels of population growth. The developed region includes all of Europe, Canada, the U.S., Australia, Japan, New Zealand and the USSR.	**Sahel** A strip of land on the southern edge of the Sahara Desert in North Africa that stretches across several countries. This area was a grassland at one time, but because of prolonged drought and land degradation, it is becoming a desert.	**Urbanization** Growth in the proportion of a population living in cities.
Death rate The number of deaths per 1,000 population in a given year.	**Irrigation** To supply crops with water in excess of what they would get from natural rainfall. Water for irrigation comes from rivers, lakes or reservoirs; channels dug by man; drains built by man; or pumped from underground water sources.	**Ozone Layer** Chemical layer that protects living things on Earth by blocking out harmful radiation from the sun.	**Salinization** The build up of salt in the soil. Too much salt build-up can damage and kill plants and destroy the soil's ability to grow plants. This process is caused by irrigation as salts brought with the water remain in the soil as the water evaporates.	**Watershed** The region from which a river receives its supply of water.

Lesson 1.2 How Much Is 5 Billion?

Overview: The purpose of this lesson is to familiarize students with the size of the world population, the rate at which it is currently growing and the historical pattern of growth. **Note: This lesson is intended to follow Lesson 1.1, which gives students an introduction to the demographic, environment and development concepts necessary for successful completion of the readings and lessons in this unit.**

Region: World

Grade Level: 7–12

Learning Objectives:

Students will:
1. Understand the effect of the rate of population growth upon the total population.
2. Interpret a line graph.
3. Demonstrate the relationship between births and deaths.

Skills To Be Developed:

1. Interpreting information
2. Conceptualizing rates and figures

Vocabulary To Be Developed:

rate of natural increase, birth rate, death rate, million, billion

Time Needed: 2 days

Materials Needed:

1. Reading: "The Challenge of Our Times"
2. Transparency of chart "World Population Growth 1750–2100" from *Student Resource Guide*
3. Lesson 1.25 "Stork and Grim Reaper"
4. Film: "World Population"
5. Copies of the *World Population Data Sheet*

Procedure:

DAY 1

1. Remind students of the previous evening's homework assignment. Ask them, "How many people live on this earth?" (5.3 billion in 1990)

2. Ask students, "How much is a billion?" This is a difficult number for most people to comprehend. Use the following examples to help your students appreciate how much one billion is. They will also help students appreciate the difference between one million and one billion.

a. A stack of U.S. paper currency one inch high will contain 233 bills. If you had a million dollars in thousand dollar bills, how high would the stack of bills be? (4.29 inches high) If you had a billion dollars in thousand dollar bills, how high would the stack be? (357 feet or almost the length of a football field)

b. How old would you be if you were a million seconds old? (11.6 days) A billion seconds old? (31.7 years)

3. After allowing time for discussion, show the chart, "World Population Growth" on an overhead projector.

4. Ask students to interpret the chart. If they have trouble, some of the following questions will help. When did the population reach 1 billion? (about 1800) Have them point to the population size in 1990. Did the population grow faster in this century or in the 1800s? (this century) Where is most of the population growth occurring now, in developed or developing regions? (developing, Africa, Asia, and Latin America) What does this mean for those regions? This reviews what students discussed during Lesson 1.1. (As population grows more resources and services are needed.) Discussion.

5. Guide them back to the chart. Tell them that it took 130 years for the population to grow from 1 to 2 billion, but just 45 years more to double to 4 billion. Each billion is being added in a shorter period of time. What causes population to grow so fast? (There are more people being born than dying, which means the population growth rate is higher than in earlier times when births and deaths were closer to being equal. The rate of population growth is about 1.8 percent this year.) Have a discussion about what this means. Compare the rate to a checking account interest rate.

6. Conduct the "Stork and Grim Reaper" exercise (see Lesson 1.25) to show the impact that a growth rate of 1.8 percent has on the earth.

7. Optional: Show the six-minute film "World Population." Discussion.

8. Assign the reading, "The Challenge of Our Times" Part 1, for homework. This may also be read in class. Ask students to note in the reading what **Child 5-Billion's** life is likely to be like.

DAY 2

1. Students have read the "Challenge of Our Times" Part 1, for homework or will read it in class.

2. Discussion. What type of life did the reading predict for **Child 5-Billion**? In your opinion, is this a positive or negative outlook? On what did the author base his predictions? What might happen to change this?

3. Optional: For review and in preparation for the activities using the data sheet, go over the first six columns on the *World Population Data Sheet* with students. Use only the world, LDCs and MDCs to discuss the meanings and variations between these variables.

Extensions & Variations:

1. Have students generate their own ways of representing 1 million, 1 billion or 5 billion. Here are some other ways of expressing millions or billions.

a. Imagine a checkerboard with squares one inch on a side. How big would the checkerboard have to be in order to have 5 billion squares? (just over a mile on a side)

b. Count one second. How many seconds are in a year? (about 31.5 million) How many years is a billion seconds? (31.7 years) What was happening 5 billion seconds ago? (It was the early 1830s. Andrew Jackson was U.S. President. Cherokee were being forced to move from Georgia. Millions of bison still roamed the open prairies.)

c. Texas is a big state, but how much room would 5 billion people each have if they moved into Texas and were spread out evenly? (about 1.5 square feet each, barely enough to stand on.)

d. How many words are there in the Encyclopedia Britannica? (about 44 million words) How many complete sets would you need to get 5 billion words? (over 110 full sets)

Lesson 1.25 The Stork and Grim Reaper

Overview: The purpose of this lesson is to illustrate the concept of the rate of natural increase (or population growth rate). This lesson is a spin-off of Lesson 1.2.

Vocabulary To Be Developed:

rate of natural increase, birth rate, death rate, carrying capacity

Time Needed: 15 minutes

Materials Needed:

1. Copies of the *World Population Data Sheet*
2. Clear container (plastic box, fish bowl, or similar; should be at least 1 quart capacity)
3. Old towel to place under clear container to absorb drips
4. Two sheets of paper labeled: "Stork" and "Grim Reaper"
5. Straight pins to attach labels to wearers
6. Bucket of water (the "Great Beyond")
7. Food coloring (add to water in bucket for easier visibility)
8. Two measuring cups or dippers: one large (perhaps 1-cup) and one small (1/3 cup)

Procedure:

1. Tell students that you are going to show them an interesting way to convey the concept of the earth's carrying capacity and to illustrate the effect on that carrying capacity of a birth rate that is larger than the death rate.

2. Tell them that the exercise is called "The Stork and the Grim Reaper." Explain that people will come into the world via the Stork, and, of course, depart it via the Grim Reaper.

3. Select two volunteers from the audience; one to be the Stork and one to be the Grim Reaper. Pin an appropriate sign on each.

4. Hold up the clear container and say: "Now, you may think this is just a container, but actually it represents the world. The water in the bucket represents people. Our stork will add people--that is add water--to our world and the Grim Reaper will take people out of the world by dipping water out of the container.

5. Instruct the class to help the Stork and Grim Reaper by looking at the *World Population Data Sheet* to find the birth and death rates. Ask: "What is the birth rate for the world?" (28 per 1,000). And what is the death rate? (10 per 1,000).

6. Tell them that the birth rate is almost three times that of the death rate, so we'll give the large dipper to the Stork and the small dipper to the Grim Reaper. Ask the Stork and the Grim Reaper to start doing their tasks—Stork, adding water, and Grim Reaper, removing water--until asked to stop. (Let them proceed until the water level gets dangerously high).

7. Ask students what is happening to the water level. (It's rising.) What will happen if there is no change in the birth or death rates? (Water will overflow.) You may wish to carry on the example to its grim implication: that losing water really means losing people, as the earth's carrying capacity is exceeded.)

8. Discussion: What does this suggest about the carrying capacity of the earth? (It has limits; if the birth rate is not slowed, a crisis could result. It is important to note trends while there is still time for thoughtful analysis and humane problem-solving.)

Extensions & Variations:

1. Show the growth rates for two different countries or regions. Use two containers and have a Stork and Grim Reaper for each; vary the size of the dippers.

Adapted by permission from *EdVentures in Population Education*, Zero Population Growth, Inc., 1984.

Lesson 1.3 In Search of Child 5–Billion

Overview: The purpose of this lesson is to provide students with ways to compare and give meaning to statistical data. The lesson will also give students information about the lives of children in other countries.

Region: World

Grade Level: 7–12

Learning Objectives:

Students will:
1. Locate information in data tables.
2. Interpret information in data tables.
3. Write essays describing hypothetical children from unfamiliar countries.
4. Compare essays describing such children from various countries.

Skills To Be Developed:

1. Reading tables
2. Creative writing

Vocabulary To Be Developed:

developed country, developing country, population density, per capita GNP, life expectancy, calorie consumption, infant mortality, total fertility rate, urbanization, gross domestic product (GDP)

Time Needed: 2 days

Materials Needed:

1. Copies of the *World Population Data Sheet*
2. Copies of the *World Environment Data Sheet*
3. Reading: "The Challenge of Our Times," Part 2

Procedure:

DAY 1

1. Distribute copies of the *World Population Data Sheet* and the *World Environment Data Sheet* (or the *Student Resource Book* containing the data sheets) to each student. Discuss the layout and column headings on each data sheet. Refer students to the glossary or data sheet definitions and notes for explanations of the unfamiliar variables.

2. Choose one country for which there are data on the World Environment Data Sheet (the *World Environment Data Sheet* does not contain all the countries that appear on the *World Population Data Sheet*.) Explain that the entire class will be working together to create a portrait of the people living in the country you picked. The only information sources are the data sheets and their accompanying tables and charts. Ask your students to find answers to the following questions in the data sheets:
   a. Is their country densely populated? (See "Countries, Areas and Densities" in the *World Population Data Sheet.*)
   b. Are the people more likely to live in the countryside or in cities? (See "Urban Population.")
   c. Does it seem to the older people in the country that there are many more people living in their area than there were when they were younger? (See "Population Change 1955–1990/1990–2025.")
   d. Are the people more likely to be poor or wealthy? (See "Per Capita GNP.")
   e. How long can a person expect to live? (See "Life Expectancy.")
   f. Are the people eating well? (See "Per Capita Calorie Supply of Requirements.")
   g. Do they live in families with lots of children or few children? (See "Total Fertility Rate.")
   h. What is the state of health of the babies here? (See "Infant Mortality Rate.")
   i. What is the source of energy used by families here? (See "Per Capita Commercial Energy Consumption," "Electric Energy from Fossil Fuel" and "Years to Halve Forest Cover.")
   j. Are people more likely to be farmers than any other occupation? (See "Gross Domestic Product (GDP) from Sources Other than Agriculture.")
   k. Does the average family drive a car? (See "Motor Vehicles per 1,000 population.")

3. Distribute the reading "The Challenge of Our Times," Part 2 to each student. Remind them of **Child 5–Billion**, to whom they were introduced earlier in the reading. They learned what this child's life might be as a world citizen. Now they will be learning about his life if he were growing up in specific countries. Their reading assignment is to find out how **Child 5–Billion** might live if he grew up in Haiti, Mauritania, Nepal, Yemen or Brazil.

DAY 2

1. Have students select two countries (other than Brazil, Nepal, Mauritania, Yemen or Haiti), one developed and one developing country. Students should attempt to select countries different from their classmates: teachers may want to assign countries to students or have students pull country names out of two hats. **Note: Once again, select countries from the *World Environment Data Sheet* for reason explained in Day 1, Procedure No. 2.**

2. For each country, have students examine the information on the data sheets and develop an idea of the conditions within the country. The data sheets provide enough information to make a sketch of the countries, however, you may want students to supplement the data with information from other sources.

3. Have students write a paragraph describing what life might be like for **Child 5–Billion,** if he or she were born in that country.

4. After completing their two paragraphs, students should select one story from the reading of **Child 5–Billion** (for example, Child of Nepal) and compare that child to the children described in their stories.

5. In small groups, have students exchange their descriptions. Have each group select a description for a developed and developing country to read aloud to the class. Share the readings and compare stories without noting the country, and ask other students to guess at least the region and country if possible.

6. Ask students to consider how some of the issues raised for one country may have an impact on other countries.

Extensions & Variations:

1. If at least one computer is available, teacher may have students create a computer database of population and environmental statistics. Each student should enter into the computer the data from his/her country/–ies. An extensive data set can be created in this manner.

2. Have students write about the future of **Child 5–Billion** if he/she were living in their neighborhood.

Section II Generic Lessons

The lessons in this section are designed to be used when studying any region or country (even those not covered in this package). They help the student gain background information about the country/region and give instruction in graphing, mapping and vocabulary development.

Lessons 2.1 and 2.2 help students practice their detecting skills as they develop profiles of the environmental and population status of their country/region. Lesson 2.3 outlines the steps for making a climate graph. Students learn how to develop and interpret choropleth (area-value) maps in Lesson 2.4. For a bit of fun, Lesson 2.5 Lingo Bingo, helps students review vocabulary. In Lesson 2.6, students learn how to construct and interpret age/sex pyramids.

Resources

From the Population Reference Bureau

Population Handbook, International Edition, by the Population Reference Bureau. Washington, D.C., 1986. 64 pp.

World Population: Facts in Focus (World Population Data Sheet Workbook), by the Population Reference Bureau. Washington, D.C., 1988. 20 pp.

Lesson 2.1 Connecting Environmental Clues

Overview: The purpose of this lesson is to give students the opportunity to explore the environment of a region prior to their exploration of the impact of humans on the environment. Students will construct graphs and interpret pictures and maps to in order to describe the environmental character of the region and speculate about the economic activities that may take place in such an environment. Students then read a description of the environment and economic activity of the region to compare to their description. **Note: This lesson is designed to be used as an introduction to any region or country reading or lesson in this package.**

Grade Level: 7-12

Learning Objectives:

Students will:
1. Construct a climate graph.
2. Interpret information from climate graphs.
3. Interpret photographs.
4. Interpret information from maps.
5. Integrate information and speculate on results.
6. Compare speculations with textual information.

Skills To Be Developed:

1. Preparing and interpreting climate graphs
2. Observing photos and graphic evidence
3. Reading maps
4. Integrating information from diverse sources

Vocabulary To Be Developed:

climate, resource

Time Needed: 1-2 days

Materials Needed:

1. Copies of climate data tables (one source is *Universal Atlas*)
2. Copies of blank climate graph forms (Lesson 2.3 Handout)
3. Photographs of region
4. Atlases with thematic environmental maps of region (sugg. *Rand McNally's Goode's World Atlas*)
5. Current world almanacs or encyclopedias

Procedure:

1. If climate data are available, distribute blank climate graph forms and have students construct them (see Lesson 2.3 for instructions to make climate graphs). If the data are not available, but the atlas contains climate graphs, move to Step 2. If no climate graphs are available, move to Step 3.

2. Analyze information presented in the climate graphs. What is the regional climate like? Is the climate conducive to agriculture? Are moisture and temperature levels favorable throughout the year or only on a seasonal basis?

3. Display slides or photographs from books or magazine articles about the region. Students should study the pictures and jot down clues about the environment, conditions of human life, productive activities and so on.

4. Distribute atlases and direct students to examine maps portraying the region's environmental character—landforms, mineral resources, climate, soil, vegetation and natural hazards.

5. If a map describing the economic activities of the region is not available, students should speculate on the likely activities, being ready to defend their reasoning. If an economic map is convenient, students should examine the map and identify the variables noted in their earlier exploration that would lead to particular activities in particular places. Students should also speculate on (if no map is available) or note (with map present) the region's relative importance for a given economic activity compared with the rest of the world.

6. Read aloud through the geographic, environmental and economic descriptions of the region contained within an almanac or encyclopedia and have students compare the description with their own.

Extensions & Variations:

1. Have students create a series of climate graphs for different sites within the region and attach them to a large map of the area.

2. Create sub-regional visual displays (pictures, dioramas, etc.) illustrating the impact of environmental factors upon human lives.

Lesson 2.2 Connecting Population Clues

Overview: The purpose of this lesson is to help students explore basic regional population facts and trends and consider the connections between population and the regional environment. **Note: This lesson is designed to be used as an introduction to any region or country reading in this package.**

Learning Objectives:

Students will:
1. Read chart and transfer selected information from one format into another.
2. Speculate on impact of population change on local environment.
3. Interpret a population pyramid.

Skills To Be Developed:

1. Reading tables
2. Conceptualizing rates
3. Interpreting graphic information

Vocabulary To Be Developed:

birth rate, death rate, growth rate, percent of natural increase, percent urbanization, percent of population under age 15, per capita GNP, infant mortality rate, total fertility rate, life expectancy

Time Needed: 1 day

Materials Needed:

1. Copies of the *1990 World Population Data Sheet*
2. Copies of "Connection Population Clues" worksheet (Lesson 2.2 Handout)
3. Copy of population pyramid from the *Student Resource Book*

Procedure:

1. Distribute *World Population Data Sheets* and the "Connecting Population Clues" worksheets. If students have not had experience working with the *World Population Data Sheet* (i.e., have not completed activity 1.3 or 1.4), take a few minutes to familiarize them with the data categories and notes.

2. Have students complete the worksheet using the *World Population Data Sheet* with the region or country being studied written at the top.

3. Discuss the worksheet. How does this country/region compare to the U.S. and the world? How do you think the human population might impact the environment in this country/region? Look at the *World Environment Data Sheet* for clues.

4. Have students examine the population pyramid for this country/region (if available in the *Student Resource Book*). What is the age structure of the population in this region? Is the population old or young? How does it compare to the U.S.? How might the population structure change in the coming 35 years? Based on the pyramid and your understanding of the environment in this region, what environmental consequences do you anticipate might result from this population structure? What kinds of goods and services are going to be important for this group?

Connecting Population Clues Worksheet **Lesson 2.2 Handout**

Region: _____

Use the **World Population Data Sheet** to find the missing information for the region or country begin studied.

1. Use the following formula to calculate the rate of natural increase.

$$\frac{\text{Birth rate} - \text{Death rate}}{10} = \text{Rate of Natural Increase}$$

Birth Rate ____/1,000 The birth rate is births per 1,000 population
– Death Rate ____/1,000 The death rate is births per 1,000 population

= Growth Rate ____/1,000 = This growth rate is change per 1,000 population

The rate of natural increase is measured as a percent. That is, a portion of 100. Divide the growth rate per 1,000 by 10 to get the rate of natural increase _____. Compare this to the figure on the *World Population Data Sheet.*

2. Now compare these rates to those for North America and the world. Are the rates for this region higher or lower?

North America's birth rate is _____ .
The world birth rate is _____ .
North America's death rate _____ .
The world death rate is _____ .
North America's rate of natural increase is _____ .
The world rate of natural increase is _____ .

3. Now examine some other variables for this region. For the items in parentheses, circle the appropriate response:

a. In this region, a person born today might expect to live ____ years. This is (longer than/about the same as/ shorter than) the world figure and (longer than/about the same as/shorter than) the North America figure.

b. In this region, _____ percent of the people live in urban areas. This is (greater than/about the same as/less than) the world figure and (greater than/about the same as/less than) the North America figure.

c. In this region, _____ percent of the people are less than 15 years old. This is (higher than/about the same as/lower than) the world figure and (higher than/about the same as/lower than) the North America figure.

d. In this region, _____ out of every 1,000 babies born die before reaching their first birthday. This is (greater than/about the same as/ less than) the world figure and (greater than/about the same as/less than) the North America figure.

e. In this region, if current rates stayed constant, women would average about _____ children each in their reproductive lives. This is (greater than/about the same as/less than) the world figure, and (greater than/about the same as/less than) that North America figure.

f. In this region, $US _____ worth of goods and services are produced per person, which is (greater than/about the same as/less than) the world figure and (greater than/about the same as/less than) the North America figure.

Lesson 2.3 Making a Climate Graph

Climate data show the patterns of temperature and precipitation for a year or several years for a specific site.

The easiest way to interpret this data is to create a climate graph. This will enable you to examine the general pattern of weather conditions. You will be able to tell warm, cold, wet and dry periods. These graphs also lead to easier comparisons between countries and regions.

The scale for the temperatures (C^{O}or F^{O}) is located on the left. Make a line graph by plotting the monthly temperatures with dots on the graph above the letter for the corresponding month. Connect the dots.

The scale for the monthly precipitation (in inches or millimeters) is located on the right side. Use vertical bars to represent the monthly precipitation.

Note: This package contains scales for both metric and U.S. measuring systems (see Lesson 2.3 Handout).

Lesson 2.4 Making a Choropleth (Area-Value) Map

A choropleth map is useful in identifying regions. Making such a map is a simple technique. The steps for drawing a choropleth map are:

1. Determine the mapping categories by finding the range of data for that indicator. Determine the number of categories to be used for your map and the interval of each category. Here is one method for determining mapping categories.

a. Inspect your data sheet.
b. Choose one measure, such as birth rate, for mapping.
c. Determine the world's (or region's) **highest** and **lowest** values for that measure.
d. Subtract these two numbers in order to calculate the **range** for the data.
e. Divide the range by the number of mapping categories planned for your map. Five mapping categories will be adequate for most measures. The number produced by the division will be how many numbers to include in each category. (Note: The best number of classes to use is the one that give you the most useful information. Generally, between three and seven works best. If too few classes are used, important details may be lost. Too many classes mean that the map gets cluttered with unimportant detail.
f. Note that the last category contains a larger interval because the range was not divisible by five. Construct categories so that the numbers in one category do not overlap those in adjacent categories.

Example of mapping categories for birth rate:

10–18	37–45
19–27	46–54
28–36	

2. Arrange a color code or shading pattern for each category. Colors or patterns should increase from light to dark, from lowest to highest category.

3. Determine the proper mapping category for each country and color or shade the country on an outline map. Title the map and place a legend on the page.

4. After the map has been drawn, consider the following to guide interpretation:

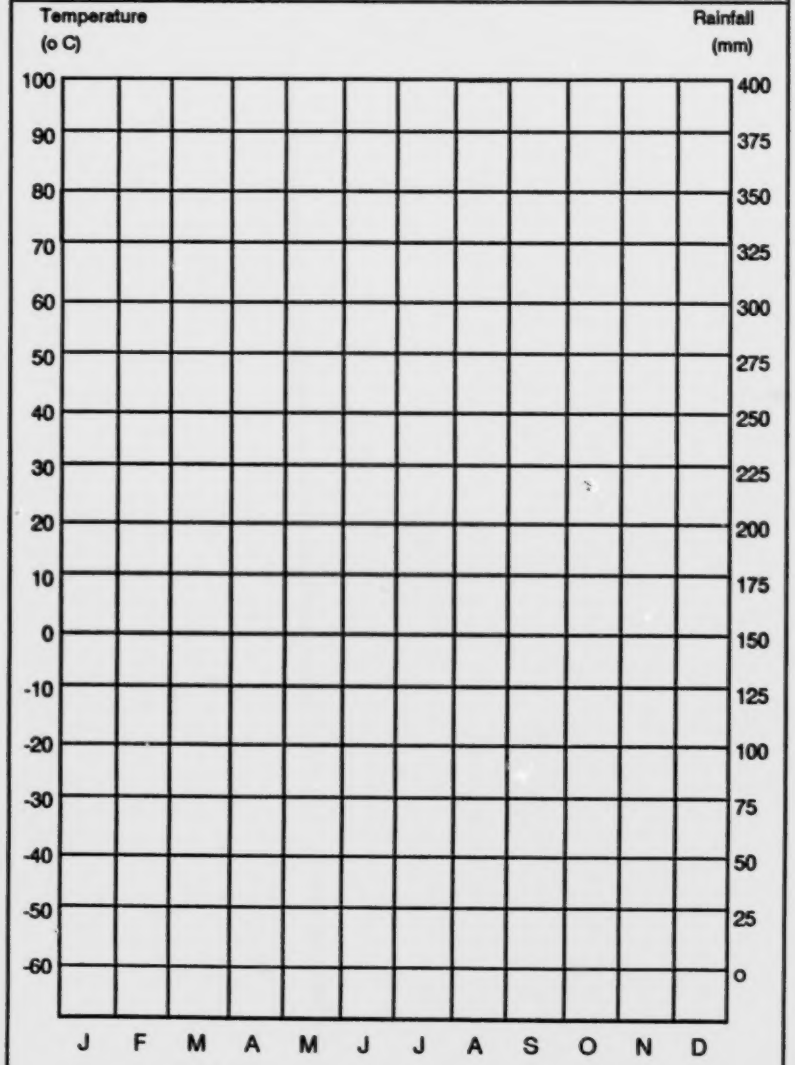
a. Describe the patterns observed on the map.
b. What accounts for the variation?
c. Discuss the factors that could lead to the range of outcomes within this distribution.

Extensions & Variations:

1. Provide mapping categories for younger students.

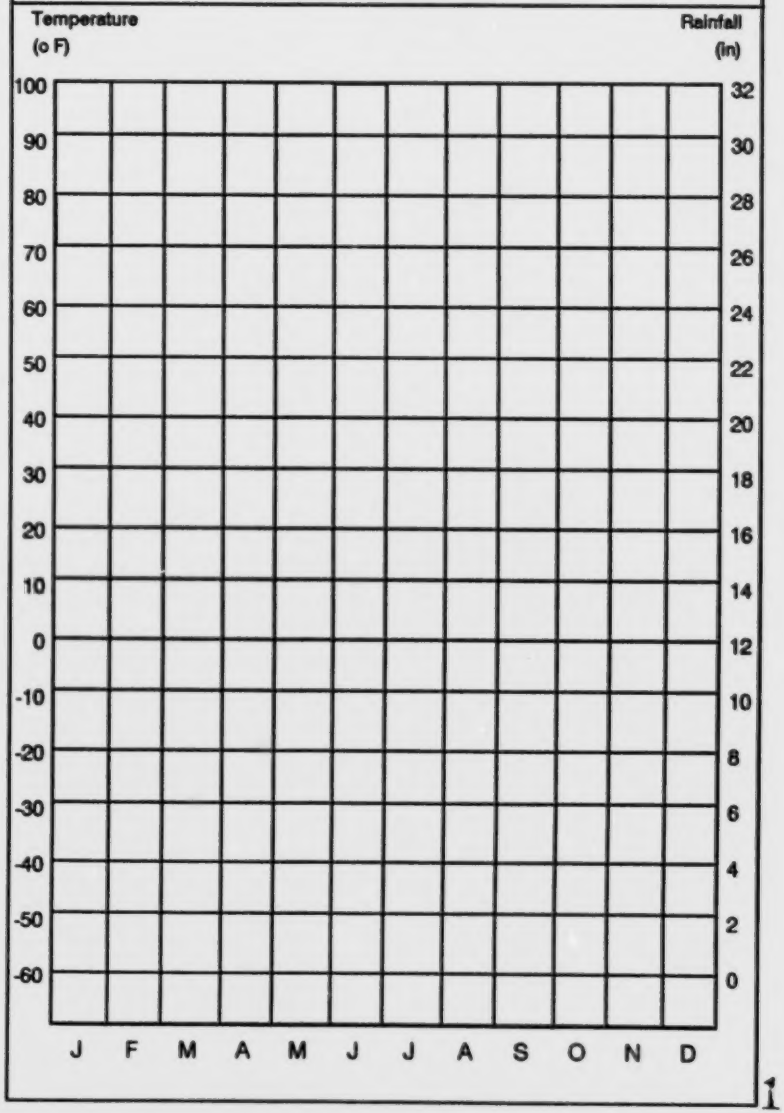
Station
Latitude

Climate Type
Longitude



Station
Latitude

Climate Type
Longitude



Lesson 2.5 Lingo Bingo

Overview: The readings in this unit have many vocabulary words that should be introduced and reviewed with students. This lesson serves as a tool for review and can be used with any vocabulary list.

Grade Level: 7–10

Learning Objectives:
Students will:
1. Define geographic, environment, population and development terms.

Skills To Be Developed:
1. Vocabulary building

Time Needed: 1 day

Materials Needed:
1. Two Lingo Bingo game sheets per student (Lesson 2.5 Handout)
2. Glossary from the appropriate reading assignment
3. Pieces of paper with the numbers 1 to 30 written on each piece

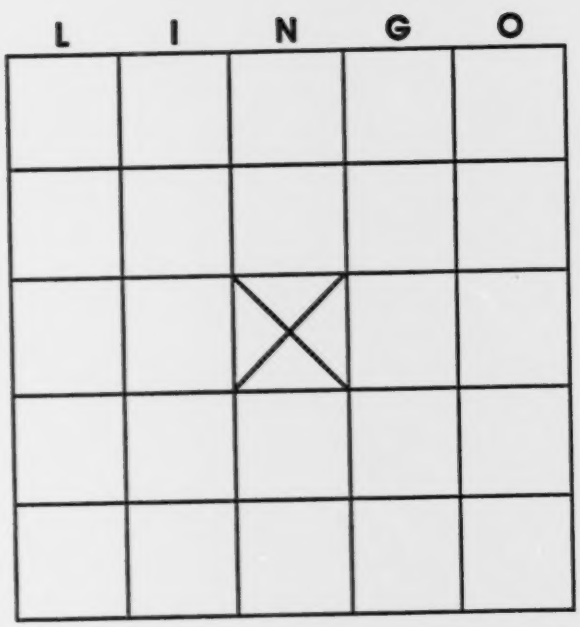
Procedure:
1. Distribute a Lingo Bingo game sheet to each student. Two rounds can be played on each sheet.

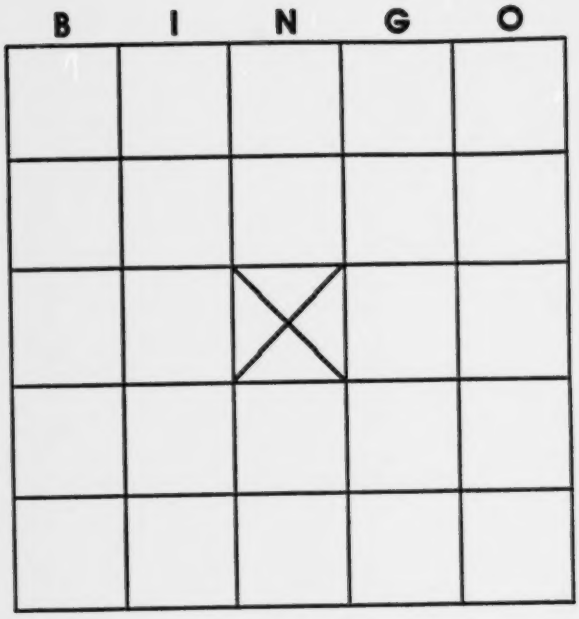
2. Have students randomly place numbers (from 1 to 30) in the 24 empty squares (students may write in the corresponding words if they wish). There are only 24 squares available so some words will not be used.

3. Select one of the numbered pieces of paper from a container. Find the corresponding number from the Lingo Bingo sheet and read the corresponding definition from the glossary. Students locate the corresponding number and word and circle it on the Lingo Bingo card. Continue with another definition.

4. When a student gets five in a row or four corners, they say "Lingo Bingo." They then repeat the words that were circled. If they are correct, they win.

5. Repeat process as necessary. It may take three games before all 30 words have been covered.





1 _____ 16 _____

2 _____ 17 _____

3 _____ 18 _____

4 _____ 19 _____

5 _____ 20 _____

6 _____ 21 _____

7 _____ 22 _____

8 _____ 23 _____

9 _____ 24 _____

10 _____ 25 _____

11 _____ 26 _____

12 _____ 27 _____

13 _____ 28 _____

14 _____ 29 _____

15 _____ 30 _____

6. Explain that each student is going to draw a population pyramid for a specific country. However, the class will practice first with the U.S. Explain that the pyramid will have only four age categories instead of 16 like the ones shown.

7. Pass out copies of a blank Modified Population Pyramid Outline (Lesson 2.6 Handout 1) (if possible give students a page with a modified pyramid on each side). Put the corresponding transparency on the overhead. Point out that males are on the left, females on the right and that they are measured as a percentage of the population. Read off the age categories. Tell students that 14 percent of females are ages 0–19. Have them draw a line from the bottom of the box at 14 percent up to the next line. Demonstrate. Do the same for the males and continue in the same manner for the other age groups.

U.S. Population by Age
(percent)

Ages	Males	Females
0–19	15	14
20–39	17	16
40–59	10	11
60+	7	10

8. Next, distribute copies of the Modified Pyramid Data Table (Lesson 2.6 Handout 2) and another copy of the blank Modified Pyramid sheet, if necessary. Organize the class into groups of four to six students each. Then assign students to graph the pyramids of particular countries, identified by numbers. (Assign the countries in numerical order. Each group will then be graphing a variety of pyramid styles.)

9. Have students share their pyramids with the other students in their group. They should discuss similarities and differences in the shapes of their pyramids. What might be some of the reasons for different shapes? For example, Country #12 has many more males than females in the 20–39 age group. (Male workers migrating from other countries.)

10. Now have students group themselves by pyramid shape. (You may wish to post large copies of the different styles of pyramids and then say, "Everyone with a pyramid that looks like Kenya, come to the front of the room....") Students should then line up by pyramid type, with broad–based, narrow–topped pyramids (rapid growth) on the left side of the room, slow–growth pyramids in the center and negative growth on the right side.

11. Students should look at the list of possible countries and guess which country they represent. After students have made their guesses, the teacher (using the key) should identify each of the pyramids graphed by the students.

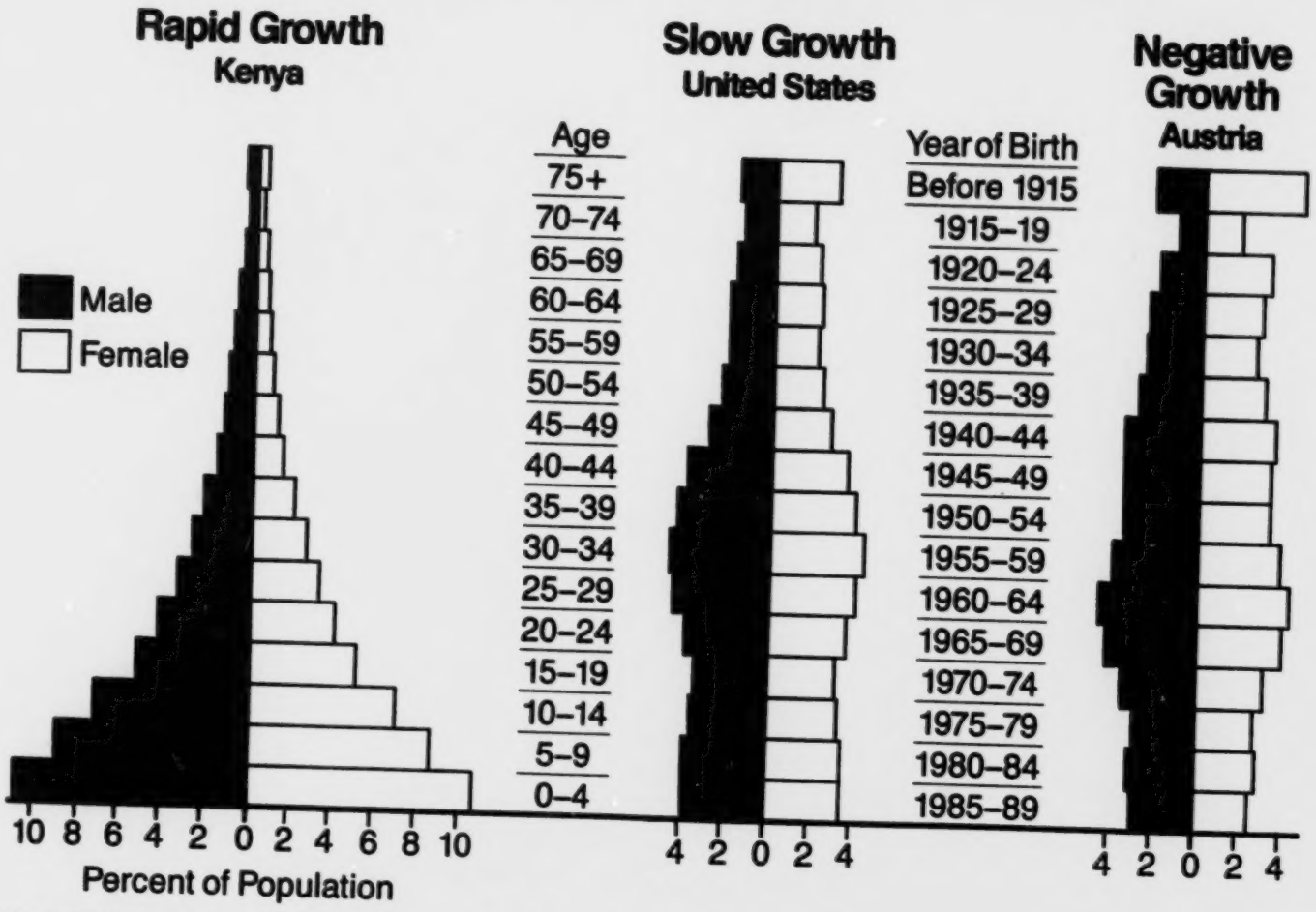
11. Students should write the name of their country on their pyramid. Distribute "Post–It"® notes and have students roughly duplicate (in bold) the pattern of their pyramid on the "Post–It,"® then attach their "Post–It"® to the world wall map.

12. Students should seek patterns among the graphs within the regions.

Extensions & Variations:

1. Create a population pyramid with 16 or 17 age groups. Obtain data from the *United Nations Demographic Yearbook* or write to the Population Reference Bureau for more information.

Three Patterns of Population Change



Source: The World Bank

Population Reference Bureau, Inc.

Modified Population Pyramid **Lesson 2.6 Handout 1**

Modified Pyramid Data Table
(percent in each age group)

Lesson 2.6 Handout 2

	MALES				FEMALES			
AGES	0-19	20-39	40-59	60+	0-19	20-39	40-59	60+
COUNTRY								
1	24%	16%	8%	4%	23%	14%	8%	4%
2	22	17	9	4	20	16	8	4
3	28	14	5	2	27	14	6	3
4	22	17	8	3	21	17	8	3
5	12	15	13	9	12	15	13	12
6	28	15	6	2	27	14	6	2
7	28	13	6	2	28	14	6	2
8	14	17	12	7	13	17	12	9
9	19	19	9	4	18	17	8	5
10	16	18	11	6	16	17	10	6
11	25	16	6	3	24	16	7	3
12	20	28	18	2	18	9	4	1
13	16	15	11	7	15	14	12	10
14	12	16	12	8	12	15	12	13
15	26	15	7	3	24	15	7	3
16	29	12	6	3	28	14	7	3
17	30	13	5	2	29	13	6	2
18	16	19	11	6	14	18	9	7
19	28	14	6	2	28	14	6	2
20	28	14	6	2	28	14	6	3
21	11	16	13	8	11	15	13	13
22	21	18	9	3	20	17	9	4
23	27	14	8	2	26	13	7	2
24	19	15	10	6	18	15	9	8
25	23	18	5	4	22	18	6	5
26	14	14	14	7	13	14	14	10
27	31	12	5	2	31	12	5	2
28	29	15	6	2	27	14	5	2
29	27	13	6	2	27	14	7	3
30	30	13	6	2	29	13	6	2
31	14	15	12	8	13	14	13	11
32	26	15	7	2	25	15	7	3
33	16	20	11	4	15	19	10	5
34	15	16	11	7	15	16	11	9
35	23	17	8	3	22	15	8	4
36	28	12	7	3	28	13	7	3
37	20	28	18	2	18	9	4	1
38	17	16	10	5	16	15	11	10
39	27	13	6	3	27	14	7	3
40	28	14	5	2	28	14	6	2

Data for 1990.
Source: The World Bank

Modified Pyramid Data Table
Teacher's Key

COUNTRY

1. India
2. Albania
3. Algeria
4. Thailand
5. Denmark
6. Bangladesh
7. Zaire
8. Canada
9. China
10. Cuba
11. Mexico
12. United Arab Emirates
13. Czechoslovakia
14. Austria
15. Egypt
16. El Salvador
17. Uganda
18. Hong Kong
19. Ghana
20. Honduras
21. Germany
22. Korea
23. Afghanistan
24. Ireland
25. Jamaica
26. Japan
27. Kenya
28. Pakistan
29. Bolivia
30. Nigeria
31. Hungary
32. Philippines
33. Singapore
34. Australia
35. Turkey
36. Ethiopia
37. Cyprus
38. USSR
39. Cameroon
40. Zimbabwe

Section III Africa

Section III begins with an overview of Africa and then moves to specific concerns in three African countries. The reading "Sustainable Development in Africa," is an overview of population trends and environmental concerns. This piece concentrates on desertification and the population explosion. There are three lessons that accompany this overview. Lesson 3.1 introduces students to the geographic environment and population growth patterns of Africa. In the second lesson, students review Africa's age structure and discuss its economic implications. In Lesson 3.3 students develop mapping skills and learn techniques to develop and test hypotheses about the relationship between economic well-being, demographic and health concerns.

As the students read about the Sahel region of Africa in "Survival in the Sahel," they learn about the complex factors leading to desertification. Lesson 3.4 is a simulation, where students become citizens of a village in the Sahel; they must deal with problems associated with land degradation. Then students develop solutions to environmental problems and evaluate the feasibility of these solutions as they explore the concepts of survival, resources and scarcity in Lesson 3.5.

Students then move east to Kenya, where they participate in a role-playing activity about family-planning and discuss the problem of deforestation in Lessons 3.7 and 3.8.

The last reading in this section, "Egypt: How to Look After the Nile," discusses the importance of water supply in Egypt. In Lesson 3.8, students assess the benefits and costs of the Aswan Dam.

Resources

Articles

"Africa's Stricken Sahel," *National Geographic* Vol. 172, No. 2 (August 1987). p. 140.

"Drought in Africa," *Scientific American* Vol. 256, No. 6 (June 1987).

"The Environmental Effects of the High Dam at Aswan," by Gilbert F. White. *Environment* Vol. 30, No. 7 (September 1988).

"Inside the Sahel," *Earthwatch* Vol. 15, No. 4 (1988).

From the Population Reference Bureau

"Africa's Expanding Population: Old Problems, New Policies," by Thomas J. Goliber. *Population Bulletin* Vol. 44, No. 3 (1989). 52 pp.

Audiovisuals

The Naked Earth. 1986, 25 minutes, Jr. High-Adult, VHS. Available for free loan. Write to: Public Affairs Office, The African Development Foundation, 1625 Massachusetts Ave. N.W., Suite 600, Washington, D.C. 20036. (202) 673-3916.

This film, produced by the National Council of Women of Kenya, presents a picture of life in Kenya and of the urgent environmental problems confronting this rapidly growing East African country. The film focuses on deforestation and the efforts of the Greenbelt Movement, a national tree-planting program. The film is locally made, has poor sound quality and the speakers often have strong accents. However these weaknesses are more than compensated for by the directness and genuineness of the presentation.

Road to Ruin: Only One Earth. 1987, 53 minutes, Jr. High-Adult, VHS. Purchase for approx. $130 from Social Studies School Service, (800) 421-4246. Available for rental from PRB.

This three-part program explores the causes and effects of the world's environmental problems by highlighting specific concerns in three regions: the Sahel, Mexico and Scotland. The program begins by showing the array of factors contributing to water shortages and the desertification of the Sahel region of Africa. It then explores destruction of the rainforest in Mexico and the elimination of herring off the coast of Scotland. The study of the history, economy and culture of the peoples in each area helps the viewer understand the complex nature of environmental problems and solutions.

Lesson 3.1 Africa's Landscape and Population

Overview: In the past, Africa's ecosystem dictated human activity on the land. In the first part of this lesson, students examine this fragile relationship. Then students examine the rate of population growth in Africa and discuss the impact of rapid population growth on the land.

Region: Africa

Grade Level: 7–12

Learning Objectives:

Students will:
1. Understand the concept and implication of desertification.
2. Identify and state characteristics of the Sahel region of West Africa.
3. Compare the population growth rates of African countries to those of other countries.

Skills To Be Developed:

1. Reading and interpreting maps
2. Reading and interpreting tabular data

Vocabulary To Be Developed:

ecosystems, the Sahel, desertification, population explosion, fallow, deforestation, water cycle, land degradation, population growth rate, doubling time, rate of natural increase

Time Needed: 2 days

Materials Needed:

1. Copies of Reading: "Sustainable Development in Africa"
2. Copies of "Examining Population Growth and Change" (Lesson 2.6 Handout)
3. Map of Africa
4. Copies of the *World Population Data Sheet* and *World Environment Data Sheet*

Procedure:

DAY 1

1. Have students read the introduction to the article (up to "The Major Problems"). Discuss with them some of the indications of ecosystem stress—famine, floods, drought and displacement of people.

2. As students read "The Major Problems" section of the article, highlight the two problems: **Desertification** and **Population Explosion**. Ask them to speculate about the meaning of these two terms, and possible relationships between them.

3. As students read the section "Desertification" (up to the section entitled "The Population Explosion"), have them write down any words or terms with which they are unfamiliar. Discuss these words, creating a class vocabulary list, either on an overhead, on the board or in their notebooks.

4. When the students have read and discussed the "Desertification" section, have them focus on the world map showing the areas subject to desertification (page 17 of the *Student Resource Guide*). Have them locate the region discussed in the reading. How much of Africa is threatened by desertification? What problems might desertification pose for the people who live in Africa? What problems might desertification pose for people in the U.S.?

DAY 2

1. Have students read "The Population Explosion" section of "Sustainable Development in Africa." Review any unfamiliar terms.

2. Distribute Lesson 3.1 Handout. Have students use the worksheet to compare population growth in Africa with seven major countries. They will be using the rate of natural increase from the *World Population Data Sheet* and population change from 1990–2025 from the *World Environment Data Sheet*. (Explain that the growth rate for a country is indicated by the rate of natural increase on the data sheet. This rate does not include growth from migration, only births and deaths.) **Note: Countries with the same rate of natural increase in 1990 may have different rates of population change between 1990 and 2025; the rates of population change assume a non-constant growth rate.**

3. When students have completed the table, they should answer the following:
   a. What is the relationship between the rate of natural increase and the percent change in

population between 1990 and 2025?
b. Compare the rates in the African countries with those of countries in other parts of the world.
c. What might be some causes of high growth rates in Africa?
d. What might be some consequences of these high rates?

Extensions & Variations:

1. Examine satellite maps of the Sahel region. What changes do they observe as they compare maps from different times? What seems to be occurring? Have them hypothesize about the appearance of a satellite map from a future year.

2. Research areas of the world where desertification is a problem. Study the climatic factors that produce the patterns of rainfall that typify West Africa. Read about human activities in this type of environment and investigate the current incidences of drought in Sahelian countries.

3. Have students create choropleth maps (see Lesson 2.4) using other variables from the data sheets.

4. Have students hypothesize about the future impact of population growth on the environment of selected countries. What additional information would they need to test their hypothesis?

Examining Population Growth and Change

1. On the map of Africa, label the 12 countries that share the southern border of the Sahara.
2. Use the *World Population Data Sheet* and the *World Environment Data Sheet* to complete the chart below.

African Countries	Rate of Natural Increase	Projected Population Change (%) 1990-2025
Burkina Faso		
Chad		
Cote d'Ivoire		
Ethiopia		
Ghana		
Guyana		
Mali		
Mauritania		
Niger		
Nigeria		
Senegal		
Sudan		
Selected World Countries		
Brazil		
China		
India		
Japan		
Mexico		
United States		

Lesson 3.2 What's In an Age?

Overview: Africa's rapid rate of population increase has meant that an extraordinarily high percentage of the population is younger than 15 years old. The purpose of this lesson is to acquaint students with the effect of this "young" population on the productivity of a region and on the generation of capital reserves for future economic growth.

Region: Africa

Grade Level: 9–12

Learning Objectives:

Students will:
1. Explain and calculate age–dependency ratios.
2. Discuss the affect that the percentage of dependents in the total population has on the prosperity and growth capacities of the economy.
3. Examine the economic needs of dependent populations and compare these needs to the contributions to the economy made by dependent populations.

Skills To Be Developed:

1. Interpreting data
2. Computing rates

Vocabulary To Be Developed:

age–dependency ratio, economic surplus, capital investment, dependent

Time Needed: 1–2 days

Materials Needed:

1. Copies of the *World Population Data Sheet*
2. Map of Africa
3. Copies of "Age–Dependency Analysis Worksheet" (Lesson 3.2 Handout)

Procedure:

1. Distribute materials to students. Locate Mali, Kenya, Nigeria and Uganda on map of Africa. Explain that they will be working with these four countries today.

2. Complete the "Age–Dependency Analysis Worksheet" with the whole class using the age–dependency statistics for the U.S. from the *World Population Data Sheet*.

3. Ask students why they think people under 15 and over 65 are classified as dependents. Ask them to brainstorm the special needs of Americans in these two age groups. What kinds of goods and services do they demand? Then ask if these two groups usually contribute to the economic activities of the society? What? How much? Why or why not?

4. Now have students complete the worksheet for the four African nations. (Kenya=108, Mali=100, Nigeria=89, Uganda=104) How do the results compare with the results for the U.S.? Discuss with the class what problems these four nations may have that might not be as problematic for the U.S. To get at this discussion, have students assume that each worker produces enough wealth for two people (him/herself and one other person). In the U.S. the 100 workers will produce enough for 200 people. Now look at the ratio of dependents to workers in the U.S.: 51.5 (52) dependents for every 100 workers. This means that 152 of the 200 units of wealth produced by the 100 workers will be consumed (100 workers + the number of dependents), leaving a surplus of 48 units of wealth for other uses.

5. Have students calculate how much extra there will be in the four African countries. (Kenya = -8, Mali = 0, Nigeria = +11, Uganda = -4) Have students discuss what these results will mean for future economic growth of the region, and brainstorm ways in which capital for future economic investment could be obtained. How might governments go about solving the problem of having too many people and too few resources? In the short–term? What about long–term solutions?

Extensions & Variations:

1. Have students compute the age–dependency ratios for other countries or regions in Africa.

Age-Dependency Analysis Worksheet

Lesson 3.2 Handout

	(Country A)	(Country B)	(Country C)	(Country D)	(Country E)
1. Percent of population under 15					
Percent of population over 65					
2. Add the two numbers in #1. This is the percent of people in the "dependent" ages.					
3. Subtract the answer in #2 from 100. This gives you the percent of people in the "working" ages in the total population.					
4. Divide the number of dependents (#2) by the number of workers (#3) and multiply this answer by 100. This gives you the number of people in the "dependent" ages for every 100 people in the "working" ages.					

Lesson 3.3 Tools for Hypothesis Formation

Overview: Africa's population will continue to grow rapidly for many years. The purpose of this activity is to provide students with the tools to show relationships between population growth and change, quality of life and economic development.

Region: Africa

Grade Level: 7–12

Learning Objectives:

Students will:
1. Formulate hypotheses about the relationships between per capita GNP and other variables.
2. Construct choropleth maps.

Skills To Be Developed:

1. Interpreting data
2. Hypothesis formation
3. Preparing thematic maps

Time Needed: 1–2 days

Materials Needed:

1. Copies of the *World Population Data Sheet*
2. Copies of outline map of Africa (two per student)

Procedure:

1. Review the following concepts: percent of population under age 15, per capita GNP, life expectancy, infant mortality and rate of natural increase with students.

2. Have students create an area–value (or choropleth) map of Africa showing distribution of rates of per capita GNP (see Lesson 2.3 for instructions). Discuss the patterns in this map.

3. Now have students count off by fives. Assign each group with one of the following variables: life expectancy, infant mortality, total fertility, percent of population under age 15 and rate of natural increase.

4. The students should make a hypothesis about the relationship between their variable and the per capita GNP for Africa. For example: Countries with higher per capita GNPs will have lower infant mortality rates.

5. Have students construct a choropleth map using the second variable. They should then use the two maps to test their hypothesis.

6. Have students present their maps and the results of their hypotheses to the rest of class. Discuss similarities in patterns and reasons for particular correlations.

Lesson 3.4 Living on the Edge

Overview: The factors leading to land degradation are complex. In this simulation, students will play the parts of villagers in the mythical village of "Goma," somewhere in the Sahel region of Africa. As the village evolves from 1960 to 1990, students will be able to examine the roles that natural events (such as droughts), population growth and other human factors play on land use and food supply.

Region: Africa

Grade Level: 7–12

Learning Objectives:

Students will:
1. Understand the relationship between population growth and land use.
2. Describe other human factors and natural influences that affect land use.
3. Explain how these factors may join to affect the rate of desertification in arid and semi-arid regions of Africa.
4. Discuss strategies that could be used to fight desertification or to deal with the factors affecting desertification.

Skills To Be Developed:

1. Simulation
2. Problem solving

Vocabulary To Be Developed:

drought cycles, fallow, desertification, Sahel

Time Needed: 2 days

Materials Needed:

1. Yarn, string or masking tape
2. Paper plate
3. 10 pieces of green tissue paper
4. Two 14 oz. bags of Hershey kisses
5. Thirty spoon-size shredded wheat, unseasoned croutons (or other bland bite-size food item)
6. 12 small plastic bags
7. Sign "Goma Village"
8. Sign "The Big City"
9. Narrators' cards (see end of script)
10. Decision-making cards (see end of script)
11. Videotape: "Road to Ruin"

Procedure:

Preparation:

1. Arrange yarn in a closed circle to represent the village. All of the students in the class should be able to stand in this village. Also arrange yarn for the shape of "The Big City" about half the size of the village.

2. Place the appropriate signs near each area.

3. Cut out the narrators' cards and the decision-making cards. Write the appropriate population size, number of deaths and number of migrants in the blanks on the cards.(See charts and special instructions for numbers, which are dependent on class size.)

4. Count out the appropriate number of kisses and shredded wheat (see instructions in the script) and place in plastic bags. Use one bag for each kind of food for each year.

5. Crumple up the 10 pieces of tissue paper and throw them inside the village area.

Script:

Today we are going to participate in a simulation called "Living on the Edge." This will help give you an idea of the lifestyles of a settled population in the Sahel region of Africa (you may wish to show students this region on a map). Sahel is an Arabic word that means "shore," in this case indicating the fragile belt of grasses and forests that stretches across northern Africa for 3,000 miles, from Senegal to Somalia, and separates the Sahara from the southern equatorial rain forests. These people live in an area where it is important to keep a balance between humans and the environment; people living in this area depend upon the land for their survival.

First, I'm going to need some of you to come up and be Goma villagers. (Quickly count out the number listed on the chart below for 1960. Randomly distribute the Narrators' cards to students, including those not yet villagers.)

(Let students become situated.) This village needs a chief. The chief makes decisions about the use of resources in the town. Who would like to be the chief? (If no one volunteers quickly appoint someone.) We also need someone to be the keeper of the trees? The green paper represents trees; this is your only resource besides your farming land. (Appoint someone.) Your job is to plant or cut down trees according to the instructions of the chief.

Can we hear from the anthropologist please? (While the anthropologist is reading the card, give the chief food [Hershey's kisses] and the decision-making card for 1960.) Chief, this is your food for this year. This is the food that is grown naturally in this area. An adequately-fed person receives one unit of food; each item represents one unit of food. You may distribute the food now.

Now we would like to hear from the Goma Historian. (While the person is reading, quietly send the appropriate number of villagers into the area and give the chief the decision-making card for 1970. For this and future rounds make sure the chief distributes the correct amount of food and orders the keeper of the trees to get rid of the appropriate number of trees.)

Now we would like to hear from the Agricultural Expert. (While the person is reading, send villagers into the area, give the chief the decision-making card for 1975, see that trees are used for fuelwood and make sure that he trades a tree for some food. Give him the appropriate trade [see information on class size], but give him the bland food [e.g. shredded wheat] instead of the candy.)

Now we would like to hear from the Weather Person. (Send in villagers, give chief the 1980 decision-making card, make sure the forest is cut for fuelwood, and see that two trees are used to trade for food.)

Now we would like to hear from the Stork. (It is 1985. In addition to the tasks listed above, the chief must appoint a person to die and send migrants to the city. Decrease the size of the village by one-third by shortening the yarn.)

Now we would like a report on the region. Let's hear from the Reporters. (It is 1991. There are no trees left so natural food is distributed, a donation equal to a tree trade is received, more people die and migrate.)

Number of Goma Villagers to be Added per Round, by Class Size

Class Size	1960	1970	1975	1980	1985	1991
20	10 (10)	2 (12)	1 (13)	2 (15)	2 (17)	3 (20)
25	12 (12)	3 (15)	2 (17)	2 (19)	2 (21)	4 (25)
30	15 (15)	3 (18)	2 (20)	3 (23)	2 (25)	5 (30)
40	20 (20)	4 (24)	3 (27)	3 (30)	4 (34)	6 (40)
# of trees remaining at end of round	10	7	5	2	0	0

(numbers in parentheses are the total numbers of Goma people to be either in the village or in the city (or dead) at the end of each round)

Number of Naturally Grown Food Units to be Distributed Each Round
(Hershey Kisses)

Class Size	1960	1970	1975	1980	1985	1991
20	12	11	11	7	10	8
25	14	13	13	8	12	10
30	18	17	17	11	15	12
40	24	22	22	14	20	16

Number of Traded or Donated Food Units to be Distributed Each Round
(Bland Food Item)

Class Size	1960	1970	1975	1980	1985	1991
20	0	0	3	6	6	3
25	0	0	4	8	8	4
30	0	0	4	8	8	4
40	0	0	5	10	10	5

Special Instructions:

If your class size is 20, your trees will trade for three units of food. In 1970 you eliminate three trees due to cutting for fuelwood; one in 1975; and one in 1980. One tree is traded during 1975, two during 1980 and two in 1985. In 1985, one of your residents migrates to "The Big City." In 1991, two of your residents die and six migrate to "The Big City."

If your class size is 25, your trees will trade for four units of food. One tree is traded during 1975, two during 1980 and two in 1985. In 1970 you eliminate three trees due to cutting for fuelwood; one in 1975; and one in 1980. In 1985, one of your residents dies and one migrates to "The Big City." In 1991, there are three deaths and eight migrants.

If your class size is 30, your trees will trade for four units of food. One tree is traded during 1975, two during 1980 and two in 1985. In 1970 you eliminate three trees due to cutting for fuelwood; one in 1975; and one in 1980. In 1985, one of your residents dies and two migrate to "The Big City." In 1991, there are three deaths and eight migrants.

If your class size is 40, your trees will trade for five units of food. One tree is traded during 1975, two during 1980 and two in 1985. In 1970, you eliminate three trees due to cutting for fuelwood; one in 1975; and one in 1980. In 1985, one of your residents dies and three migrate to "The Big City." In 1991, there are three deaths and nine migrants.

Post-Simulation Wrap Up

After the last round, have students return to their seats and discuss and evaluate the decisions that were made by the chief and the results of these decisions. What would they have done? Discuss the problems that the tribe faced and other possible solutions. Watch the videotape, "Road to Ruin."

After students have learned about the Sahel, the simulation could be re-enacted. This time, let the students make their own decisions.

NARRATORS' CARDS

ANTHROPOLOGIST

It is 1960. The Goma tribe, consisting of a population of ___ people, lives in a village in the Sahel region of Africa. This is a semi-arid region, characterized by sparse, low brush, occasional clusters of trees and growing expanses of desert. Because of their new well, dug with the assistance of the Peace Corps, the Goma have been able to settle in this area. They survive by growing crops and raising livestock.

GOMA HISTORIAN

It is 1970. Our population has grown to ___. Our people used to be nomadic, moving every few years to allow the land to regain its nutrients. But we have now become settled because of closed boundaries and the availability of water due to our well. Because we have not left our land fallow, it has lost some of its ability to grow crops, so we cannot produce as much food as before. And we are using more of our trees for fuelwood. But, we still have a decent way of life.

AGRICULTURAL EXPERT

It is 1975. The population is ___. Because of overcropping, overgrazing and the destruction of the forest, the land is becoming severely degraded. The Goma have received donations of fertilizer from a rich donor and managed to maintain their level of food production, but did not grow enough to feed their people. They were forced to sell one of the trees to obtain cash to purchase food. The clearing of the forest is causing erosion, leading to further degradation of their land.

WEATHER PERSON

It is 1980. The population of the Goma tribe is ___. The Goma are in the middle of an area experiencing a drought. Their food production has dropped dramatically. The area in which they live has experienced periodic dry spells from as far back as 100,000 years ago. But because their population has increased and the tribe is settled, they are hit harder. In order to survive they have been forced to sell two more of their trees.

THE STORK

It is 1985. I have brought more people into the Goma village. The population now stands at ___. The drought is over, but the land has been severely degraded. All of the people cannot be supported. They are forced to sell their last two trees to provide food for the people. Still, some of their young men move to "The Big City" to look for work. Infants die from diarrhea. On top of that, the government has decided to use part of their land for cash crops, so that the growing urban population can be supported.

REPORTER #1

It is 1991. The population in the Sahel region has doubled since 1960. Tribes such as the Goma live on the edge of survival. Many members of their tribe have moved to urban areas, where 40 percent of the Sahelian population lives. But even there, they face harsh living conditions. Because these people live in such a precarious environment, because of their rapid population growth, and because of their extreme poverty, they live only to survive today. Saving the environment can only come after they save themselves. Let's go to my colleague who is reporting from the Goma village.

REPORTER #2

The people in this village are facing very difficult times. The drought earlier in the decade, along with deforestation and overcropping, has led to a severe decline in the productivity of the land. The government has taken over the best piece of land for cash crops. Their harvests have been meager. They did receive a donation of food from Japan, but it was not enough. ___ of their young people have moved to "The Big City" and ___ people died this year. Life here is very uncertain.

DECISION-MAKING CARDS

1960

You will have extra food. Hand out one piece per person. Save extra for the next round.

1970

Use the surplus food from the last round and save any extra.

Your tribe has used three trees for fuelwood between 1960 and 1970. Instruct the Keeper of the Trees to get rid of three trees.

1975

You do not have enough food units and your surplus won't add enough. You decide to sell one tree which will get you ___ extra units of food. Unfortunately, this food is not like the natural food in your area and the people in your village are reluctant to eat it. You must decide who gets the foreign food. Save any surplus for the next round.
You also have used one tree for fuelwood.

1980

You do not have enough food units and your surplus won't add enough. You decide to sell two trees for ___ units of food.

You have also used 1 tree for fuelwood during this period.

1985

You do not have enough food units to feed your population. You sell your last two trees for ___ units of food.

You send ___ young men (man) to "The Big City" to work and send money back to the village. ___ infant(s) die(s) from diarrhea.

1991

You do not have enough food units to feed your population. You receive ___ units of food from donor countries.

You send ___ young men to the city to look for work. ___ people die from various infectious diseases.

Lesson 3.5 Survival

Overview: News of environmental disasters and dangers have become more and more common in recent years. In this lesson, students will develop a list of the environmental problems in the Sahel region and discuss how human actions and natural causes contribute to these problems.

Region: The Sahel

Grade Level: 7 - 12

Learning Objectives:

Students will:
1. List solutions to the environmental problems in the Sahel.
2. Evaluate feasibility of suggested solutions.

Skills To Be Developed:

1. Critical thinking
2. Brainstorming
3. Problem solving

Vocabulary To Be Developed:

exports, natural resources, scarcity, desertification, ecosystems, arable, immigration, exodus, refugee

Time Needed: 1-2 days

Materials Needed:

1. Reading: "Survival in the Sahel"
2. Copies of "Evaluation Worksheet" (Lesson 3.5 Handout)
3. Optional: Film, "Road to Ruin: Only One Earth"

Procedure:

1. Divide students into groups of three or four. Have each group select a chairperson and a recording secretary.

2. Distribute copies of the reading.

3. After discussing the vocabulary words, have students read "Survival in the Sahel."

4. Have each group answer the following questions:
a. Natural environmental problems contribute to many other problems in the Sahel. What are some of those problems?
b. How do human actions contribute to these problems?
c. What resources seem to be scarce?
d. How does scarcity of these resources contribute to other problems?
e. What are people doing to survive?
f. List some possible solutions to the problems that the people in the Sahel are facing?

5. Allow 15-20 minutes for group work.

6. Reassemble. Have each group report. Record their lists of problems and solutions on the blackboard.

7. Go back to the solutions and have the rest of the class orally evaluate the feasibility of each.

8. Have the class use the "Evaluation Worksheet" to evaluate one solution from each group. The groups should use points to evaluate each of the solutions based on the following:
a. How feasible is the plan?
b. Is the plan a long-term solution?
c. Is the plan cost effective?
After points have been assigned for each solution, add up the points. List each group's best solution on a transparency to share and evaluate as a class.

9. Follow-up. Have students suggest specific actions that the government could implement to help solve the problem.

Optional: Show the first section (about 20 minutes) of the film "Only One Earth: The Road to Ruin." It is about desertification in Africa. Have students answer the following:
a. Why has the fertility of the soil declined?
b. What resources are scarce?
c. To whom are the products exported? Why?
d. Why does the speaker say "nature is not to blame?"

Extensions & Variations:

1. Read about strategies that have been attempted to solve environmental problems in this region. Have they been successful? Evaluate them in the same manner as students' lessons were evaluated.

Evaluation Worksheet

Lesson 3.5 Handout

Solutions:	Points		
	Feasibility	Long-Term Solution	Cost Effectiveness
Group 1			
Group 2			
Group 3			
Group 4			
Group 5			
Group 6			
Group 7			
Group 8			

4 points = Excellent
3 points = Good
2 points = Fair
1 point = Poor

Lesson 3.6 A Five–Child Family?

Overview: In a society where tradition often clashes with modern ideology, decision–making may be taxing. In this lesson, students act out the decision–making process of a married couple in an urban area discussing whether or not they will add another child to their family.

Region: Kenya

Grade Level: 9–12

Learning Objectives:

Students will:
1. Discuss attitudes affecting family size in Kenya.
2. Make a decision after listening to opinions.

Skills To Be Developed:

1. Role playing
2. Persuasive speaking
3. Problem solving

Vocabulary To Be Developed:

family planning, birth rate, quality of life, birth control, population growth rate

Time Needed: 1 day

Materials Needed:

1. Reading: "Kenya: From Birth Control to Population Management"
2. Copies of Lesson 3.6 Handout

Procedure:

1. Have students read "Kenya: From Birth Control to Population Management." Then read the background statement explaining Kenya's current population situation, history and government perspective.

2. Read students the scenario that describes a specific situation involving a decision concerning family size in Kenya.

3. Choose 10 students to be the participants in the role playing activity. They will represent the friends and relatives of the couple described in the scenario. Five males and five females should be selected. Give each student a description of their character.

4. It is important to make clear to the role players that they are not to merely read the description of their character. They are to act out the opinions of their character in a spontaneous and persuasive way.

5. All students who are not role players will pretend that they are the couple who must make the important decision about whether or not to have another child.

6. Conduct the role playing activity. If desirable, have some students play the roles of the couple so that the players are actually talking to someone. When it is over, allow the rest of the students to ask questions or have discussions with the role players.

7. Poll the students. Did they choose to have another child? Why or why not? What, if any particular argument, was the most important in affecting their decision?

Extensions & Variations:

1. Have students research attitudes about family planning in other cultures.

2. Have a three–way role–playing discussion/debate involving a Kenyan government family planning official, a local village leader representing the average citizen of Kenya and a World Bank representative who is an economic advisor.

3. List all of the reasons mentioned in the activity in favor of the additional child and those against. Look at these pros and cons from a typical Kenyan perspective. Rate each positive factor in terms of importance (+1, +2, or +3) and rate each negative factor (–1, –2, or –3). Add the positive and negative ratings. Discuss and compare the findings. Would you stick with your numerical answer?

A Five-Child Family? Resource Page

Lesson 3.6 Handout

Background:

Kenya has one of the highest rates of population growth in the world--3.8 percent per year. At this rate the population would double in 18 years. The rate of growth for the world is 1.8 percent and 0.8 percent in the United States. Kenya has grown from about 11 million people in 1969 to 25 million today. The average woman in Kenya has six or seven children; the average for women in urban areas is under five. The government believes that the population growth rate is too high and family size should be reduced. The Government introduced the National Family Planning Program in 1967. However, only 20 percent of married women are using modern methods of contraception. Programs must be appreciated and supported at the community level to be effective. It is difficult to achieve support for a variety of reasons--social, cultural and practical.

Scenario:

Jomo Kababu, his wife Patience Kababu and their four children live in the coastal port city of Mombasa, Kenya, where Jomo is a dock worker. He moved his family there three years ago from their rural village about 100 miles away because he needed to make more money to support his family. Patience has a job as a maid in a European Ambassador's home; her job is necessary to supplement the family income. The two oldest children sell fruit on the streets when they are not in school. The family is more financially secure than they were in their rural village; the children go to school, there is enough food to feed everyone and the oldest children have shoes. But, they must work hard to maintain their present standard of living. Jomo and Patience are discussing whether or not to have a fifth child. Jomo thinks they should. Patience disagrees. But, neither is sure because they want to please each other and their families and to raise their children well.

Student Roles:

1. Salim Mubanzi (Patience's Father). He is very strongly in favor of the couple having more children. Besides the fact that it is a strong tradition to have a large family to carry on the family name, having children is their security in old age. When the child reaches age five or six, he/she will be able to earn money. The government has no social security system for the elderly. The more children a couple has, the more children will be available to help take care of them when they get too old to work.

2. Sarah Kababu (Jomo's Mother). She strongly favors the couple having more children because it is Patience's duty to bear many children, especially because her husband wants more. It is a duty not only because large families are a tradition, but also a blessing (from God), a tremendous source of pride and important for social status.

3. Soja Kimani (Government Employee—Family Planning Officer). He does not clearly advise for or against another child. He encourages the couple to base their decision upon the quality of life desired for the family. He wants them to carefully think about their ability to care for another family member considering their present incomes and work schedule. He encourages them to consider the effect of another child upon the family as a whole as well as upon each individual. He points out the many aspects of daily life that will or could be strained with an added family member (such as food allotments, clothing, child care, space, etc.)

4. Gichuru Adamba (Close Friend of Jomo). He thinks it is perfectly normal and desirable to have another child. He feels that the financial burden upon the family will be more than made up by government programs that will improve the quality of life for Kenyans. He feels that irrigation projects and improved agricultural methods will lower food costs. Transportation improvements will increase trade, which will increase wages and add jobs. He also feels that improved health care and sanitation methods will make life easier for Kenyans.

5. Claudette Martel (Wife of Patience's employer). She urges the couple not to have another child because of the strain that it would put on the wife and the rest of the family. She believes that it is impossible for government programs to keep up with Kenya's population growth, which she says is one of the fastest growing countries in the world. She has visited a semi-arid region of northern Kenya and has seen the results of desertification, which she thinks is largely a result of overpopulation. She fears that the effects of overpopulation will exploit the nation's resources.

6. Tenita Osimo (Patience's Sister). She feels strongly that the couple should not have another child. She points out that there are no family members in Mombasa, where the couple lives. Family members would help care for the children while the parents worked. Besides, the family has little time together now, because of their hectic lives. Another child would make the situation worse. Also, she would like the couple to send some of their income home to help take care of their elderly parents. Another child would make that impossible.

7. Abel Kababu (Patience's Uncle). He strongly feels that the couple should have more children. It is manly to have a large family, to support them and to teach them how to support each other. He feels it is especially important to have more children because they are no longer close to the extended family back in the rural village and will be lonely without enough relatives to help him in an emergency.

8. Margaret Kete (Friend of Patience from the Neighborhood). She feels that it is time for Patience to take greater control of her life and take a stronger stand against having another child. She feels that, if necessary, the wife should practice birth control without her husband's knowledge to avoid having another child. She encourages the wife to attend school and take greater control in making decisions involving her welfare.

9. Violet Ayemba (Health Technician at the Local Government Clinic in Mombasa). She urges the couple to postpone making a decision about having another child until they can agree and are more financially secure than they are now. She is anxious to make birth control devices available and explain how and when to use them.

10. Olinga Otteno (Respected Tribal Leader from the Couple's Home Village). He is strongly opposed to any form of birth control or actions to limit the family size. Children are a natural part of marriage and it is taboo to interfere with what was meant to be. If necessary, the couple should move back to the village so that the extended family would all be available to help care for the younger children.

Lesson 3.7 Deforestation: Kenya

Overview: Most environmental problems are the result of a variety of complex factors. In this lesson, students outline the human and environmental factors that contribute to deforestation in Kenya.

Region: Kenya

Grade Level: 7–12

Learning Objectives:

Students will:
1. Outline the key points of an article.
2. Identify the factors contributing to and resulting from deforestation in Kenya.

Skills To Be Developed:

1. Reading
2. Classification

Vocabulary To Be Developed:

slash–and–burn, rapid population growth, the Sahel desertification, erosion, humus, watershed, biogas, paraffin

Time Needed: 1–2 days

Materials Needed:

1. Reading: "Kenya: Fuelwood and Population"
2. Worksheet, "Deforestation" (Lesson 3.7 Handout)
3. Optional: Film, "The Naked Earth"

Procedure:

1. In small groups, have students read, "Kenya: Fuelwood and Population." As they read, have them discuss the causes and consequences of deforestation that are mentioned in the article. Complete the worksheet.

2. After students have completed the worksheet and the class has discussed the results, show the film, "The Naked Earth." As students watch the film, have them consider the following questions:

a. What percent of Kenya's foreign exchange goes to the purchase of energy products?
b. What percent of Kenya's land remains under forest cover?
c. What caused the first large–scale decimation of forests?
d. What is the single largest industrial consumer of fuelwood today?
e. What percent of Kenya's land is arable? What gets priority for scarce land resources?
f. Who controls Kenya's export market?
g. Besides industrial wood use, the greatest demand for wood is where?
h. What percent of fuelwood is converted to charcoal?
i. The narrator refers to an "environmental equation" that threatens Kenya's forests. What are the components of this equation?
j. Give examples of the evidence that is shown of soil erosion.
k. How much time does a Kenyan woman spend gathering wood each week?
l. What is the Greenbelt Movement? How does it work? Who is the Greenbelt Ranger?
m. Why does the Greenbelt Movement especially appeal to women's groups?
n. What is the greatest contribution of the Greenbelt Movement?
o. What is the significance of the film's title?

Deforestation **Lesson 3.7 Handout**

1. Factors Contributing to Deforestation

Natural	Human

2. Consequences Resulting from Deforestation

For the Environment	For the People

3. Addressing Problems Resulting from Deforestation

Solutions	Obstacles

Lesson 3.8 The Aswan Dam: Benefits vs. Costs

Overview: Egypt's pressing concerns include the pressures that a growing population places on food and water supplies. Most of Egypt's land area is desert. The Nile River is the main source of water. Building the Aswan Dam was supposed to solve the water crisis and provide energy for industrial development. Hindsight, however, reveals that there were environmental costs to the dam that its builders did not foresee. Are such high technology developments always an unmixed blessing? This lesson deals with the hidden costs of high technology on the environment. **Note: Instructors may find it necessary to research the functions of dams so that this may be explained to students. The *Atlas of Environmental Issues* (see resource list at the beginning of this section) has a concise section on dams.**

Region: Egypt

Grade Level: 9–12

Learning Objectives:

Students will:
1. Describe the geographic setting of the Nile Valley in Egypt.
2. Examine the human activities that are taking place in that setting.
3. Understand the economic concept of cost/benefit analysis.

Skills To Be Developed:

1. Observing photographic evidence
2. Hypothesizing

Vocabulary to be Developed:

reclaimed land, sustainable development, delta, oasis, salinity, sedimentation, hydrostatic, bilharzia, parasitic disease, irrigation, population growth rate, desertification, agro-management

Time Needed: 1–2 days

Materials Needed:

1. Reading: "Egypt: How to Look After the Nile"
2. Map of Egypt
3. Photographs of activities in the Nile River Valley (sugg. *National Geographic*)

Procedure:

1. **Note: Complete exercises 2.1 and 2.2 for Egypt. Or:** Have students look at the map and the photographs of the Nile Valley and make lists of characteristics of the physical environment and lists of all human activities shown in the photographs. What kind of a place is this?

2. Ask students to hypothesize about the natural resources that will be especially valued in a desert environment. Now have students read the article. As they are reading they should try to answer the question: "Should the Aswan Dam have been constructed?" Review with them, if necessary, any vocabulary terms with which they are unfamiliar.

3. When students have completed the reading, divide them into groups of three or four. As a group they are trying to make a decision about whether the dam should have been built. Have them list the costs of the dam on one side of the page and the benefits on the other. As a group, students prioritize the costs and benefits. The group should attempt to agree on a decision and be able to rationalize their priorities.

4. Have the groups share their findings with the class. Compare the priorities and discuss their rationales. Have students discuss who, from the following group, might benefit the most from the dam:
a. a farmer along the Nile who has received Aswan Dam water to irrigate his fields
b. a farmer who received no water
c. an Egyptian government official
d. an industrialist in Cairo
e. an urban worker in Cairo
f. a sardine fisherman;
g. a person who contracted bilharzia.

Extensions & Variations:

1. To show the population distribution of Egypt, pretend that the classroom is the country. Have students decide on the location of the Nile River, assuming that the front of the classroom is the Mediterranean coast of Egypt. Discuss with students

where the largest percentage of the population lives. Have all but one or two students move into the region of the class that is the "Nile Valley." Why do so many people live in such a relatively small portion of the country?

2. In groups, students role play the characters listed in Procedure #4 above. Students may need to do additional research to adequately portray their character and his/her lifestyle, position or plight. Each person in the group should individually decide whether or not he/she would be for the dam. Then the group should list all their viewpoints. As a follow-up activity after the role play, assign a short essay asking students to summarize the costs and benefits of a high technology project like the Aswan Dam.

3. Using the *World Population Data Sheet*, have students find the population growth rate for Egypt. What will happen to the population density of the Nile Valley if that growth rate continues? How will this change in population density affect the lifestyle of the people of the Nile Valley?

4. Discuss the effects that such a change in population density will have on the ecosystem of the Nile Valley.

5. Brainstorm solutions to the problems that might be created by these changes in the population density of the valley.

Section IV Asia

Section IV begins with a reading, "Asia: The Land and Its People," that gives an overview of human population growth and land use patterns. Particular attention is paid to changing weather conditions and the impact on food production. The piece considers the amount of damage done to the environment by people trying to exist on the land and the effect that this interaction might have on weather conditions and future levels of food production. Two lessons go with this reading. Lesson 4.1 guides students in an examination of the connections between climate and food production. In the second lesson, "Connecting Regions: The Ganges Watershed," students define and describe a watershed, examining the Ganges watershed in detail.

The reading "Balancing Population and the Environment: The Challenge for Bangladesh" concentrates on the changes that have occurred in Bangladesh as a result of rapid population growth. In Lesson 4.3, students classify problems in Bangladesh as physical or human and discuss the relationship between the two. In Lesson 4.4, Bangladesh's precarious position as a low sea-level country is highlighted in a discussion of the causes and sources of global warming and the impact of sea-level rise on Bangladesh.

The effect of a growing human population on land and water resources is the focus of the last Asia reading, "People-Resource Balance: A Must in the Philippines." In Lesson 4.5, students examine the causes and results of environmental degradation and rank environmental problems by their level of importance.

Resources

Books

"The Greenhouse Trap," by Francesca Lyman. Boston: Beacon Press, 1990. 190 pp.

Articles

"At the Crossroads of Kathmandu," by Douglas Chadwick. *National Geographic* Vol. 172. No. 1 (July 1987). pp. 33–65.

"China: The Ecological Challenge–Population Pressures on Resources and the Environment," *Earthwatch* No. 34 (1989). pp. 8–9.

"The Good News: Thailand Controls a Baby Boom," *Time* Vol. 133, No. 50 (November 1988). pp. 672–711.

"Long Journey of the Brahmaputra," by Jere Van Dyk. *National Geographic* Vol. 174, No. 5 (November 1988). pp. 672–711.

"The Mighty Himalaya: A Fragile Heritage," *National Geographic* Vol. 174, No. 5 (November 1988). p. 624.

"Pakistan Linking Population to Conservation," *Earthwatch* No. 40 (4th quarter 1990). pp. 3–5.

From the Population Reference Bureau

"India's Population: Second and Growing," by Pravin and Leela Visaria. *Population Bulletin* Vol. 46, No. 4 (1981).

Audiovisuals

The Fragile Mountain. 1983, 56 minutes, Jr. High–Adult, VHS. Purchase for approx. $250 from Sandra Nichols productions, Ltd., 502 Tideway Drive, Alameda, CA 94501. (415) 655–8753. Available for rental from PRB.

This excellent film shows how man must live in balance with nature in the Himalayas, where the mountainous landscape is the watershed for the Indian sub-continent inhabited by one-tenth of the world's population. The film shows how the number and intensity of floods has increased in the region as the number of people has increased. Human interactions with the land--including farming in marginal areas, the use of livestock and the cutting of the forest for fuelwood--have led to deforestation and erosion, thus effecting the drainage system for the Himalayas. Programs to stem the problem, including alternate sources of energy, are discussed.

Lesson 4.1 People in an Uncertain Environment

Overview: With more than half of the population dependent on agriculture for their livelihood, the countries of Asia are often at the mercy of the environment, especially the climate. In this lesson students will construct climate graphs for a station in South Asia and consider the connections between climate and food production. **Note: The procedure includes reading "Asia: The Land and Its People." However, you may wish to have students read the piece before beginning this lesson.**

Region: South Asia

Grade Level: 8–12

Learning Objectives:

Students will:
1. Construct a climate graph.
2. Compare climate graphs for different periods.
3. Describe connections between climate patterns and food supply.
4. Relate variations in climate to the meeting of basic needs.

Skills to be Developed:

1. Preparing graphs
2. Critical thinking

Vocabulary to be Developed:

climate graph, monsoon, drought

Time Needed: 2–3 days

Materials Needed:

1. Reading: "Asia: The Land and Its People"
2. Copies of climate data tables (Lesson 4.1 Handout)
3. Copies of blank climate graphs (see Lesson 2.3 Handout)
4. Graph paper
5. Copies of blank map of South Asia
6. *World Environment Data Sheet*

Procedure:

1. Discuss the term "monsoon." Explain to students that the monsoon (Arabic word meaning "wind") is a pattern of seasonally changing winds that dominates life in the South Asia region. The agricultural cycle depends upon the regular pattern of the summer monsoon, which brings rain for the staple grain crops upon which many people rely. In most years the monsoon rains arrive on schedule; but, occasionally the rains are late or just do not come at all. In such years, drought leaves crops withering in the fields.

2. Have students read pages 1 to 3 in the reading (stop at "Carrying Capacity"). Discuss the results of the drought mentioned in the reading.

3. To help them understand the impact of drought, have students construct climate graphs for several years in the mid 1980s. Instead of having students construct all four climate graphs, have them "count off" and construct only one graph each. When they are finished, they should find students with the other three graphs and compare for variation. (See Lesson 2.1 "Connecting Environmental Clues" for instructions.) Data for this time period for the Amritsar station in the wheat producing region of India's Ganges Valley are found in Table 1.

4. Ask students if they think drought is a common occurrence or a chance, one–time event. In order to test their answer, have students construct a graph showing the average rainfall for June, July and August from 1960–1989, using data in Table 2. (A three–color line graph would be the best way to do this.) What pattern does this graph reveal?

5. Discuss the implications of variations in rainfall for people dependent on agriculture to meet their basic needs. Refer to the *World Environment Data Sheet* to determine the "Daily per Capita Calorie Supply as a percentage of the FAO Minimum Requirement" for the countries of South Asia. What would happen if the food supply were diminished due to drought?

6. Describe the connection between climate patterns and food production in South Asia. What are some social and political implications of this connection?

7. Have students read the rest of the Asia paper.

Discuss the implications of population growth on food production in Asia. What implications does population growth have on land use for food production? What is the relationship between population growth, climate patterns and food production?

Extensions & Variations:

1. Investigate patterns of rainfall for the U.S. Are some regions in the U.S. subject to cycles of drought. Locate any such regions on a map and construct climate graphs to illustrate patterns of climate. Is the risk of drought more or less serious for the U.S. than for South Asia? Why or why not?

2. Conduct research in order to compare recent patterns of drought in Africa's Sahel region with patterns identified in South Asia. What are the similarities or differences?

TABLE 1. Temperature and Precipitation Data for Amritsar, India (31 N, 74 E)

1985	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temp. (C):	12	15	21	26	31	32	29	30	29	23	18	14
Prec. (mm):	19	5	106	39	24	49	269	178	205	133	2	71
1986												
Temp. (C):	11	14	18	24	30	32	30	29	27	23	18	12
Prec. (mm):	2	61	20	36	29	24	180	193	93	5	11	23
1987												
Temp. (C):	12	15	19	25	26	31	31	30	29	24	17	13
Prec. (mm):	32	12	44	4	119	29	66	95	17	38	0	6
1988												
Temp. (C):	12	15	18	26	31	32	29	29	28	23	18	13
Prec. (mm):	12	15	88	12	0	49	218	144	309	5	0	47

Source: Joint Agricultural Weather Facility

TABLE 2. Precipitation Data for Amritsar, India: 1960 - 1989 (mm)

	June	July	August
1960	55	181	123
1961	26	257	274
1962	9	130	155
1963	11	103	65
1964	42	330	192
1965	0	223	108
1966	118	149	140
1967	4	139	388
1968	17	313	217
1969	12	218	123
1970	237	59	200
1971	117	199	340
1972	63	80	51
1973	151	174	332
1974	24	224	176
1975	83	229	140
1976	80	208	--
1977	117	127	167
1978	113	230	351
1979	95	177	13
1980	91	404	162
1981	0	365	36
1982	17	47	115
1983	5	123	101
1984	40	284	245
1985	49	269	178
1986	24	180	193
1987	29	66	95
1988	49	218	144
1989	34	275	75

Source: Joint Agricultural Weather Facility

Lesson 4.2 Connecting Regions: The Ganges Watershed

Overview: The Ganges—sacred river of South Asia, giver of life, deliverer of destruction—is the focal point of one of the earth's great watersheds. Up to 450 million people live within the catchment area of this great river, and depend upon it for life. But the ever-increasing numbers of people have created pressure on the land that threatens to destroy the delicate environmental balance which has supported life in the region for so long. In this lesson students will use maps and visual aids to understand the watershed and its problems. Then they will seek solutions through a role-play activity.

Region: South Asia

Grade Level: 9–12

Learning Objectives:

Students will:
1. Define and locate a watershed.
2. Describe the physical, demographic and economic characteristics of the Ganges watershed.
3. Identify problems associated with human activities within a watershed.
4. Suggest possible solutions for problems affecting watersheds.

Skills To Be Developed:

1. Reading maps
2. Interpreting maps
3. Problem solving

Vocabulary To Be Developed:

watershed, region, environmental degradation, deforestation, erosion, siltation, tributary, floodplain

Time Needed: 3–4 days

Materials Needed:

1. Copies of sketch map of river systems (Lesson 4.2 Handout)
2. Copies of blank map of South Asia, including rivers
3. Comprehensive atlas (sugg. *Rand McNally's Goode's World Atlas*)
4. Videotape: "The Fragile Mountain"

Procedure:

1. a. To help students understand the concept of a watershed, distribute copies of Lesson 4.2 Handout. Instruct students to use colored pencils to enclose each separate river system (draw a box around the river and the tributaries that go to that river). Point out that each enclosed area is a watershed.

b. Now encourage students to formulate a definition of "watershed." Have students share their definition and decide on one good definition.

2. Review the definition of a "region." Ask students to explain how a watershed is an example of a region.

3. Distribute copies of a blank map of South Asia. Have students identify and label the Ganges River and its major tributaries. Instruct students to enclose the Ganges watershed using a colored pencil.

4. Have students compare their map of the Ganges watershed with a physical map of South Asia in an atlas. Identify the major physical sub-regions of the Ganges watershed: mountains (Himalayas), floodplain, delta. Have students indicate these sub-regions on their maps of South Asia.

5. Now direct students to examine a population distribution map of South Asia in the atlas in order to describe the distribution of population within the watershed.

6. Finally, have students examine a map of the predominant economies of South Asia, and describe the main economic activities within the Ganges watershed.

7. To reinforce their observations, have students develop a narrative description of the physical, demographic and economic characteristics of the Ganges watershed.

8. As a class, watch "The Fragile Mountain." (The video is 60 minutes long; it may be best to show it in two parts.) While watching, direct students to:
a. Compare the visual images in the film with the map and narrative descriptions that they have developed;
b. Note problems, both causes and effects, that are shown in the film.

After watching the film, guide students in a brainstorming session to develop a list of human and environmental problems that could or do affect the entire Ganges watershed. Once the list has been prepared, have students classify the problems according to the sub-region(s) affected: mountain, floodplain, delta.

9. Engage students in a problem-solving activity by announcing that they will participate in a "Ganges Watershed Regional Planning Conference."
   a. Divide the class into four groups representing Nepal, India, Bangladesh and the United Nations Environmental Program. Instruct each group to prepare a position paper and a list of proposals, representing their particular point of view, for addressing the most serious human and environmental problems facing the watershed region. (See Table 1 on this page for suggestions if students find it difficult to develop their proposals.)
   b. When each group has prepared proposals, convene the conference. Allow time for each group to present its proposals. Then allow each group to raise questions or objections concerning recommendations of other groups. Students must now negotiate for a regional plan that serves the interests of their group and of the region as a whole.

10. As a wrap-up exercise, have students discuss the connections between:
   a. Human activity and the local environment,
   b. Human activity in one place and the regional environment,
   c. Problems and solutions in one location and problems in another part of the region.

Extensions & Variations:

1. Have students create a poster or bulletin board depicting the Ganges watershed that incorporates pictures or illustrations of problems affecting the people and environment of the region.

2. Have students, working in small groups, research other watershed regions in the world to compare both problems and solutions with those studied in the Ganges watershed.

3. Encourage students to prepare a map of the watershed of a river near your community or in your state. Have them identify human and environmental connections between various uses of the watershed and problems or potential problems which may exist. How might use of the watershed in one area affect its potential use elsewhere? What laws exist to protect the watershed from abuse?

Some Ideas for Addressing Problems Facing the Ganges River Watershed

1. Pass laws forbidding the cutting of trees on the mountain slopes.
2. Build several flood control dams.
3. Relocate people living in areas affected by environmental degradation.
4. Pass laws limiting family size.
5. Establish tree nurseries that employ local farmers.
6. Apply for assistance from other countries.
7. Initiate programs of reforestation.
8. Open training centers to teach new farming techniques.
9. Limit the number of cattle or goats that each family can own.
10. Encourage the development of tourist attractions to generate income within the area.
11. Purchase dredging equipment to remove silt from the main channels of the river.
12. Build a new highway so that fuel oil can be purchased as a substitute for fuelwood.

NOTE TO TEACHER: The above list is in random order and includes suggestions only. It is not meant to be comprehensive, and students should be encouraged to develop ideas of their own as well. It should also be noted that not every suggestion in the list is either practical or good for the region. Students should be encouraged to question the list and consider the consequences of any course of action.

River Systems

Lesson 4.3 Profiling Human–Environment Interaction

Overview: Following the format for developing a country profile, students will use readings, maps, data sheets and photographs to understand the conditions that affect life in South Asia's poorest country.

Region: Bangladesh

Grade Level: 7–12

Learning Objectives:

Students will:
1. Describe the physical environment of Bangladesh.
2. Describe the population of Bangladesh, including size, distribution and standard of living.
3. Explain the relationships between population pressures and environmental problems, and quality of life.

Skills to be Developed:

1. Classification
2. Reading tables
3. Interpreting data
4. Observing photographic evidence

Vocabulary:

migration, silt, delta, tidal wave, water table

Time Needed: 1–2 days

Materials Needed:

1. Reading: "Balancing Population and the Environment: The Challenge for Bangladesh"
2. *World Population Data Sheet* and *World Environment Data Sheet*
3. Atlas
4. Maps of Bangladesh
5. Photographs of Bangladesh (sugg. *National Geographic*)

Procedure:

1. Have students read "Balancing Population and the Environment: The Challenge for Bangladesh." As they read, have them make a list of problems confronting people in this country. When they have completed the reading, direct them to classify their list of problems as either physical or human. Allow time for students to discuss and compare their lists.

2. Follow the format described in Lessons 2.1 and 2.2 of this guide for developing environment and population profiles of a country.

3. When students have completed the profile of Bangladesh, discuss the relationship between the physical and human characteristics of the country and the problems described in the reading.

Extensions & Variations:

1. Create a timeline tracing the history of Bangladesh (previously East Pakistan) from 1947 until today. Speculate on how political circumstances in Bangladesh may have contributed to problems faced by the country today.

Lesson 4.4 Global Crisis--Local Disaster: Bangladesh

Overview: Global warming, resulting from a buildup in the earth's atmosphere of certain gases (known as greenhouse gases), is the focus of much attention and concern. In this lesson, students will use tables, charts, and maps to identify: 1) gases associated with global warming; 2) countries which have high net emissions of greenhouse gases; and 3) Bangladesh's connection to this global dilemma.

Region: Bangladesh

Grade Level: 7-12

Learning Objectives:

Students will:
1. Identify greenhouse gases and their sources.
2. Relate increasing concentrations of greenhouse gases to population growth.
3. Locate major producers of greenhouse gases.
4. Explain some consequences of global warming.
5. Relate the physical and human characteristics of Bangladesh to consequences of global warming.

Skills to be Developed:

1. Reading charts and tables
2. Interpreting data
3. Interpreting thematic maps
4. Hypothesizing

Vocabulary to be Developed:

global warming, greenhouse gas, carbon dioxide, methane, nitrous oxide, chloroflourocarbons

Time: 2-3 days

Materials Needed:

1. Readings: "Balancing Population and the Environment: The Challenge for Bangladesh" and "Disappearing Deltas"
2. Data table "The Greenhouse Index" (Lesson 4.4 Handout)
3. *World Population Data Sheet* and *World Environment Data Sheet*
4. Maps of Bangladesh
5. Atlas

Procedure:

1. Review "The World in 2000 AD" in the article "Balancing Population and the Environment: The Challenge for Bangladesh." Review the environment and demographic profiles (see Lesson 4.3 or conduct Lessons 2.1 and 2.2 for this section) of Bangladesh, identifying major problems faced by this country.

2. Read "Disappearing Deltas."

3. Using the table, "Greenhouse Gases," discuss the following questions:
   a. What is the cause of global warming?
   b. Which gases are responsible for most global warming?
   c. What is the connection between global warming and population growth?

4. Examine the *World Population Data Sheet* and *World Environment Data Sheet*. Which columns tell something about energy use in a country? What information is not provided? Based on this information, try to determine the countries that are the greatest contributors to global warming.

5. Now examine the table, "Greenhouse Gas Producers," consider the following questions:
   a. Which countries are the six major producers of greenhouse gases? (Did these match the guesses from examining the data sheets?)
   b. What are the sources of greenhouse gases in these countries? What variations do you observe? How might you explain these variations?
   c. Compare Bangladesh to the top producers of greenhouse gases, in terms of amount and sources of emissions.
   d. Since it is only a minor contributor of greenhouse gases, do you think Bangladesh should be concerned about global warming? Explain your answer.

6. Based on the readings and discussion, have students identify some consequences of global warming. (Be sure that sea level rising and changes in precipitation patterns are mentioned.)

7. Direct students to review the physical and human

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characteristics of Bangladesh. Then allow time for brainstorming ways in which Bangladesh might be affected by global warming.

8. Distribute or project on an overhead, maps showing the distribution of population in Bangladesh and the coastal elevation of Bangladesh.To stimulate thinking, have students consider the following possible conditions:

a. Assume a rise in sea level of one foot; on the elevation map, shade the area that would be inundated pink.

b. Assume a rise in the sea level of two feet; on the elevation map, shade the area that would be inundated red. Compare the elevation maps with the population distribution map; speculate on the effect of sea level rise on the people of Bangladesh.

c. Assume a change in precipitation patterns in South Asia. How would the population and economy of Bangladesh be affected by increased precipitation? Decreased precipitation?

9. Using Bangladesh as an example, explain the connection between changes in the global environment and local conditions at a particular place.

Extensions & Variations:

1. Using the table "Greenhouse Gas Producers," encourage students to examine world patterns of greenhouse gas production by constructing a choropleth map.

a. Classify the producers into four categories on the basis of emissions produced.

b. Assign related colors (darkest for highest, lightest for lowest, etc.) to the four groups. Shade and label the countries on a world map.

2. Using the table "Greenhouse Gas Producers," reclassify the countries according to the major source of emissions. Examine the new lists for patterns according to the type of emission.

3. Working in small groups, have students consider the effects of global warming on other countries or regions of the world, such as coastal areas; major grain producing areas or the area in which they live.

Table 1. The Greenhouse Index: 50 Countries with the Highest Greenhouse Gas Net Emissions, 1987

Country	Greenhouse Index Rank	Greenhouse gases: Carbon Dioxide	Methane	CFCs(a)	Total	Percent of Total
United States	1	540,000	130,000	350,000	1,000,000	17.6
U.S.S.R	2	450,000	60,000	180,000	690,000	12.0
Brazil	3	560,000	28,000	16,000	610,000	10.5
China	4	260,000	90,000	32,000	380,000	6.6
India	5	130,000	98,000	700	230,000	3.9
Japan	6	110,000	12,000	100,000	220,000	3.9
Germany, Fed. Rep.	7	79,000	8,000	75,000	160,000	2.8
United Kingdom	8	69,000	14,000	71,000	150,000	2.7
Indonesia	9	110,000	19,000	9,500	140,000	2.4
France	10	41,000	13,000	69,000	120,000	2.1
Italy	11	45,000	5,800	71,000	120,000	2.1
Canada	12	48,000	33,000	36,000	120,000	2.0
Mexico	13	49,000	20,000	9,100	78,000	1.4
Myanmar	14	68,000	9,000	0	77,000	1.3
Poland	15	56,000	7,400	13,000	76,000	1.3
Spain	16	21,000	4,200	48,000	73,000	1.3
Colombia	17	60,000	4,100	5,200	69,000	1.2
Thailand	18	48,000	16,000	3,500	67,000	1.2
Australia	19	28,000	14,000	21,000	63,000	1.1
German Dem. Rep.	20	39,000	2,100	20,000	62,000	1.1
Nigeria	21	32,000	3,100	18,000	53,000	0.9
South Africa	22	34,000	7,800	5,800	47,000	0.8
Cote d'Ivoire	23	44,000	550	2,000	47,000	0.8
Netherlands	24	16,000	8,800	18,000	43,000	0.7
Saudi Arabia	25	20,000	15,000	6,600	42,000	0.7
Philippines	26	34,000	6,700	0	40,000	0.7
Lao People's Dem. Rep.	27	37,000	1,000	0	38,000	0.7
Viet Nam	28	28,000	10,000	0	38,000	0.7
Czechoslovakia	29	29,000	2,200	2,700	33,000	0.6
Iran	30	17,000	6,400	9,000	33,000	0.6
Argentina	31	13,000	12,000	5,500	31,000	0.5
Korea, Rep.	32	21,000	2,900	5,400	29,000	0.5
Turkey	33	16,000	3,600	9,200	29,000	0.5
Romania	34	25,000	3,100	0	28,000	0.5
Venezuela	35	19,000	4,700	3,200	27,000	0.5
Yugoslavia	36	15,000	2,800	8,200	26,000	0.4
Malaysia	37	22,000	1,400	2,500	26,000	0.4
Belgium	38	12,000	1,200	12,000	25,000	0.4
Algeria	39	8,400	12,000	4,100	25,000	0.4
Peru	40	22,000	870	0	23,000	0.4
Bangladesh	41	2,300	20,000	0	22,000	0.4
Ecuador	42	19,000	570	1,700	21,000	0.4
Greece	43	7,000	1,100	12,000	20,000	0.4
Korea, Dem. People's Rep.	44	18,000	2,300	0	20,000	0.3
Portugal	45	3,700	1,000	13,000	17,000	0.3
Egypt	46	9,000	3,100	5,100	17,000	0.3
Bulgaria	47	15,000	660	1,600	17,000	0.3
Austria	48	6,500	960	9,100	17,000	0.3
Zaire	49	16,000	790	0	16,000	0.3
Cameroon	50	16,000	580	0	16,000	0.3

(a) Chloroflourocarbons
Carbon dioxide heating equivalents, 000 metric tons of carbon
Source: World Resources Institute.

Lesson 4.5 Balancing People and Resources

Overview: The fragile resource base of the Philippines is threatened by its rapidly growing population. In this lesson students will exercise reading and data collection skills to evaluate and propose solutions to human and environmental problems in the Philippines.

Region: Philippines

Grade Level: 8–12

Learning Objectives:

Students will:
1. Identify and explain causes of resource degradation.
2. Explain the connection between population pressure and environmental degradation.
3. Suggest and evaluate possible solutions for environmental problems.

Skills to be Developed:

1. Classification
2. Reading tables
3. Interpreting tables
4. Problem solving

Vocabulary To Be Developed:

natural resource, population growth rate, upland, sedimentation, erosion, mangroves, migration, slash-and-burn farming, quality of life, sustainable economic growth

Time Needed: 2 days

Materials Needed:

1. Reading: "People-Resource Balance: A Must in the Philippines"
2. Copies of *World Population Data Sheet* and *World Environment Data Sheet*
3. Copies of "Prioritizing Grid" (Lesson 4.5 Handout)

Procedure:

1. Have students read "People-Resource Balance: A Must in Philippines." As they read, have them make a list of problems contributing to or resulting from environmental degradation. In particular, students should note the following root causes and effects on land and water resource degradation, listed in paragraph 3 on page 4:

a. high population growth rate
b. poverty
c. skewed distribution of resources
d. undervaluation of natural resources
e. ineffective government controls
f. greed

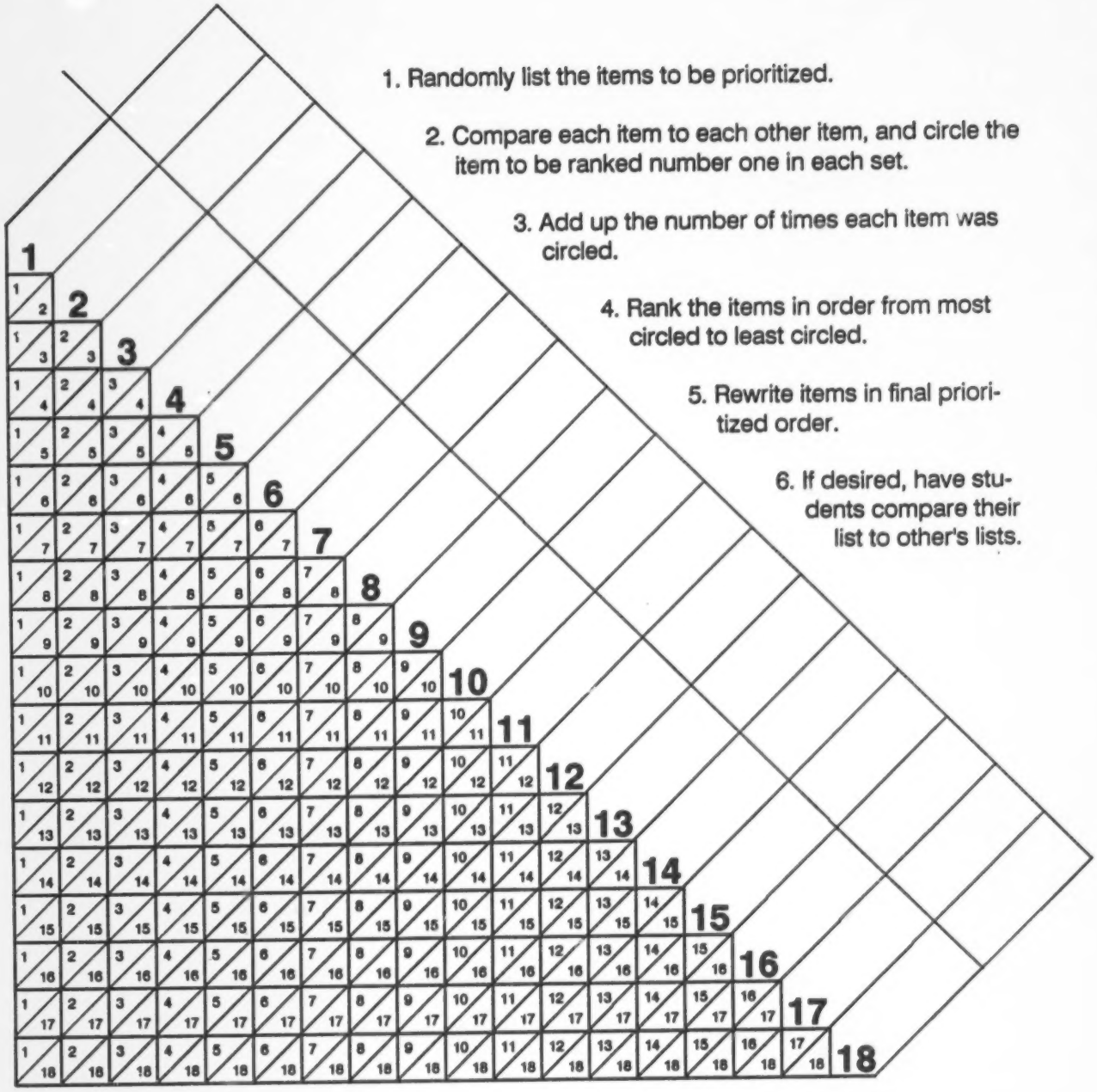
2. Divide the class into six small groups and assign each group one of the conditions listed in #1 above. Using information found in the reading and in the data sheets, have each group develop an explanation, supported by facts and examples, of the condition that they have been assigned.

3. Allow time for each group to present a summary of their findings to the class. They should explain how the assigned condition contributes to environmental degradation and give examples of both causes and consequences. And they should speculate on the reasons why the condition exists.

4. When each group has made its presentation, have students discuss the problems they consider to be most serious. Working as a class, or again in small groups, have students classify the problems that they have identified in terms of priority. This can be done through discussion or by using the "Prioritizing Grid."

5. Once students have established the problems they consider most important, guide the class in a discussion of possible solutions. Remind students that even solutions have consequences that may not be obvious at first.

6. In conclusion, ask students why it is important to establish priorities in problem solving. Also ask them why different groups often set different priorities, even when presented with the same set of problems.



1. Randomly list the items to be prioritized.
2. Compare each item to each other item, and circle the item to be ranked number one in each set.
3. Add up the number of times each item was circled.
4. Rank the items in order from most circled to least circled.
5. Rewrite items in final prioritized order.
6. If desired, have students compare their list to other's lists.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

Section V Latin America

"Latin America: Population Growth and the Environment," is an overview of the population, environment and economic conditions in this region. Lessons 5.1, 5.2 and 5.3 deal with urbanization, a major concern in Latin America. In Lesson 5.1, students locate the major cities in Latin America and examine their geographic, political and economic characteristics. In Lesson 5.2, they examine the rapid population growth in these urban areas through a three dimensional graphing activity. The third lesson, "The Urban Environment," leads students to a discussion of urban environmental problems and the obstacles to solving these problems in both developed and developing countries.

Resources

Articles

"Andean Settlers Rush for Amazonia," *Earthwatch* No. 39 (3rd quarter 1990). pp. 7–9.

"Hug a Tree, Kiss an Herb," by S. Seibert. *Newsweek* Vol. 113, No. 50 (May 1, 1989).

"A Prescription for Slowing Deforestation in Amazonia," by Philip M. Fearnside. *Environment* Vol. 31, No. 4 (May 1989).

"Rondonia: Brazil's Imperiled Rainforest," *National Geographic* Vol. 174, No. 6 (December 1988). pp. 772+.

"Saving the Rainforests," *Scholastic Update* (Teacher's Edition) Vol. 122, No. 11 (Nov. 3, 1989).

Audiovisuals

The City: Implications for the Future. 1972, 21 minutes, High School–Adult, 16mm. Available for rental from PRB.

The film is a study of the problems that come with urbanization, using Bogota, Colombia, as an example. It examines the reasons for flight from the rural areas to the urban centers, and the need for services (for example, the PROFAMILIA family planning program) and jobs to accommodate rural migrants.

The Urban Dilemma. 1987, 28 minutes, Jr. High–Adult, VHS. Purchase for approximately $40 from PBS Video, 1320 Braddock Place, Alexandria, VA 22314–1698. (800) 424–7963. Available for rental from PRB.

This program tracks and compares urbanization in developed and developing countries and discusses problems such as pollution, sanitation and housing.

Lesson 5.1 The BIG Cities of Latin America

Overview: The city has dominated social and cultural horizons of Latin America because opportunities and hope for a better future are generally found in the city. In this lesson students will locate cities in Latin America, discuss the reasons for city sites and examine the character of large cities.

Region: Latin America

Grade Level: 7–12

Learning Objectives:

Students will:
1. Locate large cities in Latin America.
2. Speculate about the urbanization patterns in Latin America.

Skills To Be Developed:

1. Identifying locations
2. Preparing maps
3. Classification
4. Hypothesizing

Vocabulary To Be Developed:

urbanization

Time Needed: 1 day

Materials Needed:

1. Map of Latin America
2. World Atlas (sugg. *Rand McNally's Goode's World Atlas*)
3. Copies of blank political map of Latin America
4. Overhead transparency of chart "Largest Urban Areas in the World in 1950, 1990 and 2000" (included)

Procedure:

1. Have students use the atlas to locate the following Latin American cities: Belo Horizonte, Bogota, Buenos Aires, Caracas, Guadalajara, Lima, Mexico City, Monterrey, Porto Alegre, Rio de Janeiro, Santiago and Sao Paulo.

2. By using inquiry methods and the atlas (thematic maps), have students develop a list of the common characteristics of these cities. Use an overhead projector or the board to construct a chart or have students develop their own charts. The following is a list of possible characteristics to examine.

a. Location (coast or inland, geographic features at site, hemisphere)
b. Political (capital city)
c. Economic (role in country's economy)
d. Cultural life

3. Now have students compare Latin American cities to other large cities in the world. Show a transparency of the chart, "Largest Urban Areas in the World in 1950, 1990 and 2000." Are most of the world's large cities located in the northern or southern hemisphere? Why are more cities located north of the Equator? Is this a surprise? Where are other cities of similar size located? Are more in Europe? Asia? America?

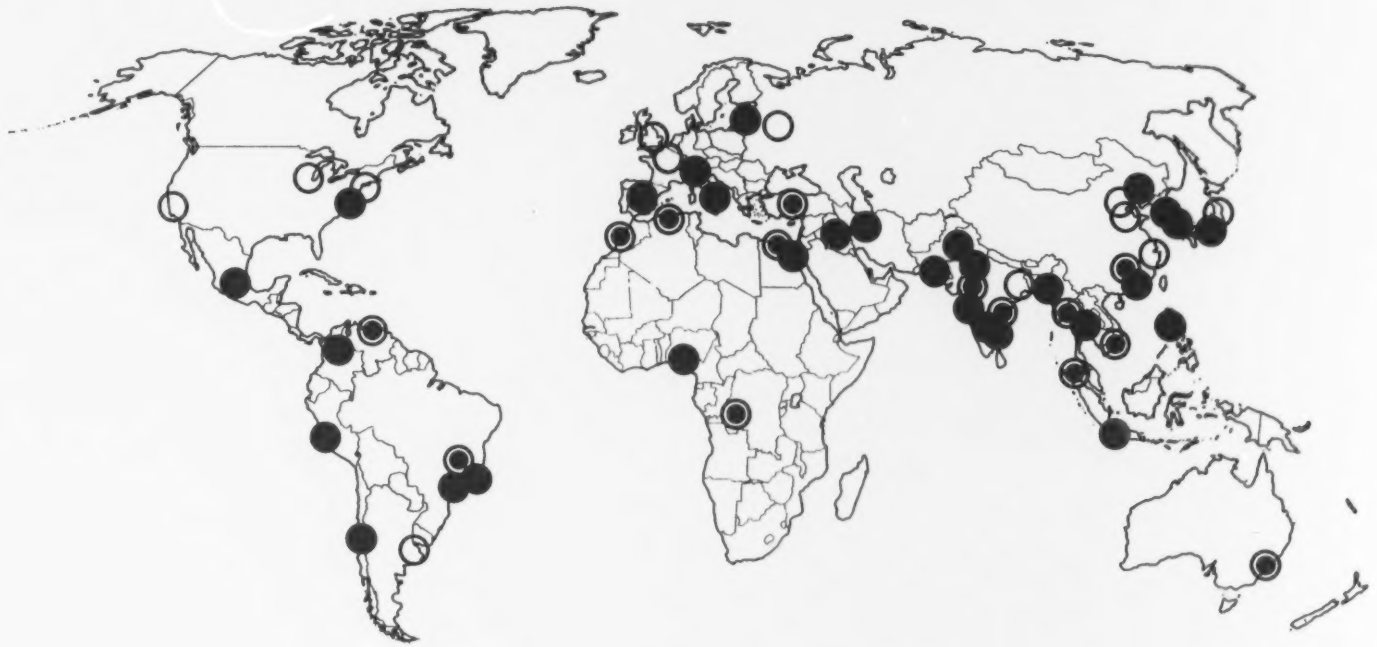
4. Look at other thematic maps of Latin America. Do these cities have similar climates, topography, sources of energy, natural hazards, economic patterns, and most importantly, what is the population pattern surrounding these cities? What conclusions are you able to draw about Latin American "millionaire" cities?

Extensions & Variations:

1. A city is called a "primate city" if it is by far the largest city in a country and dominates in terms of size and political, economic and cultural importance. Examine the 12 cities listed in Procedure #1 and determine if any of these cities fits the definition of "primate city." Some questions: What proportion of the country's population resides in that city? Is it the capital city? What is the country's economy like? Where is the country's economic center? Where do people who are seeking a "better life" migrate?

2. Further examine the background of Latin American cities. Are they former colonial regions? Is migration from the countryside a major factor in their growth? Is technology or industrial development in the country a factor in their growth? What other nations are providing incentives for growth in these countries?

Largest Urban Areas in the World in 1950, 1990 and 2000



Source: United Nations.

Population Reference Bureau, Inc.

Lesson 5.2 Millionaire Latin American Cities

Overview: There are more cities of over 2 million people in Latin America than there are in the U.S. In this lesson, students will construct three dimensional graphs to demonstrate growth of urban regions in Latin America. **Note: This lesson is designed to follow Lesson 5.1 "The BIG Cities in Latin America." Students learn about the location of these cities in this lesson.**

Region: Latin America

Grade Level: 7-12

Learning Objectives:

Student will:
1. Construct three dimensional graphs.
2. Describe the patterns of population growth in Latin American cities.
3. Examine the urban and rural population distribution in Latin America.

Skills To Be Developed:

1. Preparing graphs
2. Interpreting data

Time Needed: 1-2 days

Vocabulary To Be Developed:

urban, rural

Materials Needed:

1. 32 blue poker chips, 95 red poker chips, 114 white poker chips
2. Large map of Latin America
3. Copies of Table 1 with population figures for selected Latin American cities (Lesson 5.2 Handout)
4. Copies of the *World Population Data Sheet*
5. Reading: "Latin America: Population Growth and the Environment"

Procedure:

1. Break students into 12 groups with two or three students per group. Using Table 1 (Lesson 5.2 Handout) showing the list of the 12 largest cities in Latin America, assign a city to each group of students. Have students construct a three dimensional graph of the population growth from 1960 to 2000 for their city. To do this: use the poker chips in the following manner: each chip represents 1 million people. Blue = 1960, Red = 1990, White = 2000. Round off the population figure given for each of the 12 cities to the nearest million. Stack the appropriate number of chips for each year on the map close to the city location. **Note: Instructor may want to demonstrate with the whole region of Latin America. 1960 = 107 million, 1990 = 324 million, 2000 = 416 million. Use two chips per 100 million people for this example.**

3. Have students explain the growth patterns for these cities. Have students speculate on reasons for the rapid growth. What would likely be the average age of people in these cities? Look at the *World Population Data Sheet* to determine the percent of the population under age 15 in that country. (The average age is probably fairly young.) How is that going to influence future population growth? (These people will be adding to the population by having children.)

4. Now have students use the poker chips to represent the urban and rural populations of Latin American countries and compare them to other regions of the world. Assign one of the following regions/countries to each group: Latin America, Africa, Asia, North America, Europe, Brazil, Argentina, Chile, Peru, Colombia, Mexico and Venezuela. Using the *World Population Data Sheet*, find the column showing the percentage of population residing in urban areas. Using one poker chip to represent 10 percent, graph the urban and rural populations for each area. Use blue poker chips for urban and red for rural.

5. Have the students compare the graphs for the five regions. How does the urban population in Latin America compare to other regions? How do the urban populations in Latin American countries compare to one another?

6. Discuss the consequences of rapid urban growth in terms of the environment and in meeting the needs of the urban population. How difficult is it to provide services, particularly those that will reduce environmental pollution (such as rapid transit) or

health problems (such as providing sanitary water), to a large and rapidly growing population? Here are some U.S.examples:

a. The cost to build the Washington D.C. subway system to-date is $5.6 billion. In 1990 the system was 73 miles long. Plans are to build to 101 miles at a total cost of $10 billion. Building began in 1969 and 89 miles are expected to be completed in 1993.

b. In 1853, the construction of the Washington D.C. water system began. When it opened in 1859 it was already inadequate to serve the population. It was expanded and was completed in 1907. The total cost $4.5 million. Between 1850 and 1910 the population grew from 52,000 to 331,000.

Extensions & Variations:

1. Students might enjoy going further with this activity by creating a list of the largest urban areas, in the world for 1960, 1990 and 2000 and repeat the exercise using the chips. For a vivid visual effect, a world map could be placed on the floor.

2. Have students research the growth patterns of cities in more developed countries.

Table 1

Lesson 5.2 Handout

Latin American Cities
Population Size 1960, 1990 and 2000 (projected)
(in millions)

City	1960	1990	2000
Belo Horizonte	0.87	3.81	5.01
Bogata	1.30	5.59	6.94
Buenos Aires	6.69	11.58	13.05
Caracas	1.28	3.96	4.79
Guadalajara	0.88	3.06	3.89
Lima	1.69	6.50	8.78
Mexico City	4.93	19.37	24.44
Monterrey	0.88	2.88	3.75
Porto Alegre	1.01	3.11	3.94
Rio de Janeiro	4.93	11.12	13.00
Santiago	2.03	4.70	5.58
São Paulo	4.71	18.42	23.60

Source: United Nations

Lesson 5.3 The Urban Environment

Overview: Rapid growth in Latin America has been one contributor to environmental problems in some cities--air pollution, lack of sewage, inadequate waste disposal, etc. In this lesson students will read about specific incidences of environmental problems in Latin American cities, discuss the origins of those problems and compare them to environmental problems in more developed countries.

Region: Latin America

Grade Level: 7–12

Learning Objectives:

Students will:
1. Discuss the sources of environmental problems in Latin American cities.
2. Research environmental problems in developed countries.
3. Compare and contrast efforts to correct environmental problems in Latin America with developed countries.

Skills To Be Developed:

1. Classification
2. Speculation
3. Research skills
4. Analysis of problem solving

Time Needed: 2–4 days

Materials Needed:

1. Reading: "Latin America: Population Growth and the Environment"
2. Copies of newspaper page, "Tales From An Urban Diary" (Lesson 5.3 Handout)

Procedure:

1. Review or read, "Latin America: Population Growth and the Environment." Discuss the environmental problems that are mentioned in the article. Ask students to list the causes and explain how they impact the environment. Point out the extra stress from growing populations, the difficulty governments have in adapting to such rapid change and the effect of the economy.

2. Review the last part of the discussion from Lesson 5.2. What are the consequences of rapid population growth on the environment?

3. Explain to students that they are now going to read about some specific environmental incidents in Latin America cities. Pass out the newspaper page, "Tales From An Urban Diary," to students. Have them read the page.

4. Ask students if they think any of the stories are true. Have them indicate the stories that they believe are true and ask them why they think these are valid. Tell them that all of the stories are true.

5. Ask the following: How could these problems happen? Why don't they just clean them up? What are the obstacles to correcting these problems?

6. Ask them if they can think of similar problems occurring in the U.S. or other developed countries. What was done in these situations?

7. Have students select a specific situation in the U.S. or other developed nation. Possible topics include: toxic waste dumps, medical waste, landfills, nuclear testing, water pollution, acid rain, smog, sewage. Use periodicals and newspapers from the library for research. Students should try to answer the following questions. How did this happen? How much time passed between the time the problem started and the public reacted or a disaster occurred? Why wasn't the problem taken care of immediately? What were some of the obstacles to solving the problem? (Consider: technology, political and monetary factors.)

8. Have students present reports to the class. Compare U.S. problems with Latin American problems.

Extensions & Variations:

1. Have students write an issue of "Tales From An Urban Diary."

2. Have students calculate the age-dependency ratio (see Lesson 3.2) for Latin American countries. Do they think that these countries have the money to attack environmental problems?

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Tales From An Urban Diary
Environmental Nightmares

School's Out for Local Children

Smog Delays Classes

Mexico City schools opened two hours late to protect schoolchildren in this severely polluted city from the hazards of atmospheric inversions, most common on winter mornings. During the last week of January 1987, respiratory problems were 23 percent higher than in the six previous weeks.

Washing the Sky Out With Soap?

Air-Cleansing Spray Linked to Respiratory Disease

In Santiago, Chile, a mixture of water and detergent has been sprayed over the city in order to fight smog. The airplane service that sprayed the detergent claims that it helps particles stick to the water, which then drizzles downward. The service says that the drizzle is so light that residents do not notice it, but physicians have reported an increase in respiratory illnesses, especially among children.

Cardboard Houses Built on Swamp of Human and Animal Waste Lead to Epidemic of Sanitation-Related Diseases in Port-au-Prince Haiti

And on the Fifth Day—No Car

Mexico City's Innovative Way of Curbing Air Pollution

Residents in Mexico City must leave their cars at home one day a week or face fines equivalent to $115. The program, "Day Without a Car," was started by governemnt policymakers to help combat air pollution. Ecologists say that the 3 million vehicles are responsible for two-thirds of Mexico City's air pollution. Studies have shown that the air was three times as noxious this year as in 1986.

Knee Deep in Muck

Balboa Street, in Colon, Panama, is knee deep in a fetid, week-old pool of dark water, half-covering mounds of garbage and emitting a stream of maggots. A resident remarked, "The stench is overwhelming. It disgusts me." She believes that the clogged sewer and rotting garbage is the reason that her baby is always sick.

More Babies Suffering Blood Poisoning

According to a study, 70 percent of all newborns have unacceptable levels of lead in their blood. Lead in children has been shown to cause reduced intellectual capacity. At least 85 percent of air pollution comes from motor vehicles. Many still use leaded gasoline.

Birds Dropping Like Flies

Fowls Fall to Foul Air

The air of Mexico City is so polluted that thousands of robins and cedar waxwings, flying over the city on their annual migration last year, died. Their bodies unexpectedly rained down on the city below. Alarmed residents gathered the birds and presented hundreds of them to the environment ministry. The government claimed that the birds died both from pesticide poisoning they received in the United States and from exhaustion.

More on page 2

Lesson 5.4 You Can't Hear a Tree Fall If You Are Not Listening

Overview: Deforestation is a major global ecological issue. However, a variety of viewpoints on this issue exist within one culture. Students investigate and develop proposed solutions to the questions raised by this environmental issue and adapt them to a Latin American culture.

Region: Latin America

Grade Level: 7–10

Learning Objectives:

Students will:
1. Develop a working understanding of opportunity costs.
2. Research and evaluate the issue of deforestation.
3. Organize researched information and prepare responses for panel/debate format.
4. Present findings to class based upon their assigned role in society.
5. Establish criteria for evaluating viewpoints.

Skills To Be Developed:

1. Critical thinking
2. Research skills
3. Role playing
4. Decision-making

Vocabulary To Be Developed:

deforestation, greenhouse effect, opportunity costs

Time Needed: 3–5 days

Materials Needed:

1. Reading: "Latin America: Population Growth and the Environment"
2. Copies of "Panel Considerations and Viewpoints" worksheet (Lesson 5.4 Handout 1)
3. Copies of "Decision Making Grid" (Lesson 5.4 Handout 2)
4. Overhead transparency of excerpt from *The Next One Hundred Years*

Procedure:

DAYS 1 and 2

1. If time allows, have students review the reading, "Latin America: Population Growth and the Environment." If they have not already read it for another activity, ask them to read from the beginning to the "Watershed Management" section.

2. Lead students in a discussion of how the environment affects their quality of life. As part of the discussion, ask students to focus their attention on Latin America. Poll them as to which environmental issue has the most significance for the region and what are the reasons for their choices. Recognize the validity of all opinions, but focus on the issue of deforestation and its economic impact.

3. Project the excerpt from *The Next One Hundred Years* on an overhead projector (or pass out copies) and ask students to read it. Keep the quotation available throughout the activity.

4. Divide the class into the following six groups: Subsistence Farmers, Loggers, Cattle Ranchers, Environmentalists, U.S. Government Observers and Latin American Government Officials.

5. Groups' objectives: Through library research each group will defend the group's position on the following statement: "Deforestation releases carbon dioxide into the atmosphere and reduces the absorption of this greenhouse gas through photosynthesis, in this way adding to the global warming threat." They need to prepare:
   a. their reaction to the statement,
   b. their reasons for this stand and
   c. a list of the immediate versus long-term results of their position.

6. Suggestions for preparing and conducting presentations: Ask groups to delegate responsibilities for providing data to all group members. Each group should provide statistical information, an oral report and visual aids. All group members should appear in costume for the presentations. (Presentations may be videotaped to be used as a future teaching aid.)

DAYS 3–4

1. Distribute the handout entitled, "Panel Considerations and Viewpoints" to every student. Inform students that the handout is for personal note taking purposes. They will use their notes during the question and answer session which will follow the six presentations.

2. You will act as the moderator. Introduce the first group. (Recommended order of presentation: a) Cattle Rancher, b) Subsistence Farmer, c) Logger, d) Environmentalist, e) National Government Official, and f) U.S. Government Observer.) The group responds to the objectives outlined in Procedure #5 (Days 1–2).

3. Have as many groups as time allows do their presentations. If you must continue on Day 4, summarize the day's activities and instruct the students to formulate a synopsis for each viewpoint presented that day. Do the same thing when the presentations are finished on Day 4.

DAY 5

1. Distribute the "Decision–Making Grid" (Handout 2) to every student. Using their notes from the "Panel Considerations and Viewpoints" sheet, students should review the viewpoint of each group and indicate on the grid whether they would respond positively or negatively to each of the criteria. (Note: Space has been left for two additional concerns that may be drawn from class suggestions.)

2. Discuss the results of the completed grids as a class. Contrast the incidence of personal economic choices with those of more general concern. Explain to your students the need to understand that every viewpoint or opinion is susceptible to biases and subjectivity. The result of subjective choices is opportunities gained or lost. Recognizing opportunity or indirect costs of a decision may result in more informed choices—those that benefit not only individuals, but society and its future.

Excerpt: *The Next One Hundred Years* by Jonathan Weiner

"Climatologists believe the [forest] clearings may raise local temperatures in large areas of the tropics by as much as 3 to 4 degrees Centigrade—a local warming that is larger than the tropics can expect from the greenhouse effect. That may drive the climate of the topics beyond the conditions that gave rise to the forests in the first place. In the next hundred years large portions of the equatorial rain forest belt, the greenest wilderness in the world, could turn into some of the fiercest desert."

Panel Considerations and Viewpoints

Statement: Deforestation releases more carbon dioxide into the atmosphere and reduces the absorption of this greenhouse gas through photosynthesis, in this way adding to the global warming threat.

Reactions and Viewpoints

1. Cattle Rancher

2. Subsistence Farmer

3. Logger

4. Environmentalist

5. Latin American Government Official

6. U.S. Government Observer

Decision-Making Grid

Lesson 5.4 Handout 2

Alternatives	Criteria: Job Security	Limiting Greenhouse Effect	Personal Income	International Relations	Increased Tax Revenue	Future Quality of Life		
Subsistence Farmers								
Loggers								
Cattle Ranchers								
Environmentalist								
Latin American Government Official								
U.S. Government Observer								

Section VI World Wrap–Up

The reading for the final section, "World Citizens Must Change Their Ways," describes how a variety of people from different countries all contribute to the "greenhouse effect." It details the contributions of these citizens and suggests possible ways that they might change their behavior to reduce their contribution to global warming. This article stresses that although there is such diversity among people on the globe, they all contribute to a common problem. Therefore, finding solutions must also be a joint effort.

Lesson 6.1 encourages students to think about their connections to people in other places and how local consumption may affect global resource availability. It also gives students the opportunity to consider ways that they can help improve the environment.

Resources

Books

Earth. The Earth Works Group. Berkeley, CA: Earthworks Press, 1989. 96 pp.

The Global Ecology Handbook: What You Can Do About the Environmental Crisis. The Global Tomorrow Coalition. Boston: Beacon Press, 1990. 414 pp.

Articles

"Twenty–Five Everyday Ways to Help Clean Up Our Planet," by D. MacEachern. *Ladies Home Journal* Vol. 107, No. 244 (April 1990). pp. 224.

"Will Changing Your Lightbulbs Save the World?" by C.A. Moore. *International Wildlife* Vol. 19 (May–June 1989). pp. 18–23.

"Your Contribution to Global Warming," by G. Barnwell. *National Wildlife* Vol. 28, No. 53 (February–March 1990) (special issue).

Audiovisuals

Do We Really Want to Live This Way? (from the "Race to Save the Planet" series). 1990, 60 minutes, High School–Adult, VHS. Purchasing information from the Annenberg/CPB Project at (800) LEARNER, P.O. Box 1922, Santa Barbara, CA 93116–1922. Available for rental from PRB.

The price of progess––smog, toxic wastes and contamination of once–pristine waters––is examined as this program investigates the byproducts of Western industrial lifestyles.

Only One Atmosphere (from the "Race to Save the Planet" series). 1990, 60 minutes, High School–Adult, VHS. Purchasing information from the Annenberg/CPB Project at (800) LEARNER, P.O. Box 1922, Santa Barbara, CA 93116–1922. Available for rental from PRB.

This program explores the global commons of the atmosphere. The worldwide impact of global warming demands an international response that may be the biggest environmental challenge that society has ever faced.

Spaceship Earth: Our Global Environment. 1990, 25 minutes, Jr. High–High School, VHS. Purchase for $32.95 (includes postage) from WORLDLINK, 8755 W. Colgate Ave., Los Angeles, CA 90048. (213) 273–2636.

This award–winning production does an excellent job of illustrating the critical problems of global warming, deforestation and ozone depletion, while at the same time presenting workable solutions. Hosted by young people, the film takes viewers around the world and to outer space as they discuss the ways consumption in one part of the world may affect life in another. The music–video style of this production makes it appealing to a wide audience. This presentation includes interviews with rock musician Sting, the director of the United Nations Environment Programme, and words from world astronauts and cosmonauts.

Lesson 6.1 Wrapping Up: Making Global Connections

Overview: The products and resources that an individual consumes can have an impact on the global environment and other world citizens. The purpose of this lesson is to help students understand that the actions of people in one part of the world may affect people in other regions. Students also evaluate their own actions.

Region: World

Grade Level: 7–12

Learning Objectives:

Students will:
1. Explore the impact of local actions on the global environment.
2. Explain the consequences of one person's actions.
3. Relate the physical and human characteristics of an area with respect to an environmental problem.

Skills To Be Developed:

1. Brainstorming
2. Speculation
3. Problem solving

Vocabulary To Be Developed:

campesinos, methane, carbon dioxide, slash–and–burn agriculture, deforestation, chloroflourocarbons, greenhouse gas, greenhouse effect

Time: 2–3 days

Materials Needed:

1. Reading: "World Citizens Must Change Their Ways"
2. Videotape: "Spaceship Earth"

Procedure:

1. Ask students to come up with some ideas of how things they do and products they use may affect people living in other countries or the global environment. Give them time to brainstorm.

2. Have students read, "World Citizens Must Change Their Ways."

3. When students have finished reading, discuss the impact that the actions of each person described in the article could have on the environment. Who do you think contributes the most to the "greenhouse effect?" Discuss some of the solutions described to limit contributions to the greenhouse effect. Can you think of other solutions?

4. Now have students break up into smaller groups. Have students choose a topic (such as deforestation, acid rain, land degradation). Have them pick some "world citizens" and list some ways that each may contribute to this problem.

5. Share each group's "world citizens" with the class. Discuss contributions, possible solutions and the viewpoint of each citizen.

6. Watch the videotape, "Spaceship Earth."

7. Discuss the videotape. Have students review the impacts of citizens' actions on other citizens. Have students again discuss how their actions might affect other world citizens. Have them brainstorm about programs in their community being implemented to help the environment. Have them evaluate these programs. What else can they do?

Extensions & Variations:

1. Have students record the products they use in a diary. Discuss the implications of their choices.

2. Have students carry their garbage in trash bags for a week (one bag for recyclable and one for non–recyclable items, dispose of perishables). Have them weigh them, analyze the garbage, discuss the impact on the environment and the global links.

3. Analyze the garbage used in your school or home in a day.

4. Have students put on a play. Each student takes on the role of a piece of garbage in a trash can. They discuss where they came from, their purpose, their life expectancy, etc.

5. Have students analyze the changes on an uninhabited island, which would derive from activities of humans on other lands. How is the island connected to the rest of the world? How is it affected by natural systems such as water, air

currents and animal movements? What comes to the island by way of these global links?

6. As a creative writing exercise, have students develop their own versions of the nursery rhyme, "The House That Jack Built." The poem should show the interconnections between practices or desires in one part of the world and environmental problems elsewhere. For example, students could connect the desire for fast-food burgers in the developed world to cattle ranching and deforestation in the less developed world.

7. Lead students in a discussion of the complex nature of solutions to environmental problems. Use styrofoam containers as an example. Is styrofoam packaging an environmental problem? If yes, brainstorm solutions to the problem. Follow the discussion of the implications of those solutions (such as resources, factories, individuals who would be affected).

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